Glenbard Wastewater Authority
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10 Year Facility Planning

Continuity • Collaboration • Commitment

December 2018

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Glenbard Wastewater Authority

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10-Year Facility Planning

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
AOR	actual oxygen requirement
avg	average
BNR	biological nutrient removal
BOD5	5-day biochemical oxygen demand
C	Celsius
CCTV	closed-circuit television
cf	cubic feet
CIPP	cured-in-place pipe
CMAP	Chicago Metropolitan Agency for Planning
CMOM	Capacity, Management, Operation, and Maintenance
CSRP	Collection System Rehabilitation Program
DAF	design average flow
DMF	design maximum flow
DMR	discharge monitoring report
DNR	Department of Natural Resources
DO	dissolved oxygen
EcoCAT	Ecological Compliance Assessment Tool
EPA	Environmental Protection Agency
F	Fahrenheit
FeCl3	ferric chloride
FOG	Fats, oils, and grease
FPA	Facility Planning Area
FPR	Facility Plan Report
fps	feet per second
ft	feet
FVFS	Fox Valley Fire and Safety
FY	fiscal year
gal	gallons
gcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GIS	Geographical Information System
HDPE	high density polyethylene

LIST OF ABBREVIATIONS (CONTINUED)

ABBREVIATION	DESCRIPTION
HP	horsepower
hr	hour
HSPF	Hydrological Simulation Program FORTRAN
IEPA	Illinois Environmental Protection Agency
I/I	infiltration and inflow
L	liter
LA	load allocation
lbs	pounds
l.f.	lineal feet
in	inch
max	maximum
MCC	motor control center
mg/L	milligrams per liter
MGD	million gallons per day
min	minimum or minute
mL	milliliter
MLSS	mixed liquor suspended solids
mm	millimeter
MOP	Manual of Practice
MOS	margin of safety
NH3-N	ammonia nitrogen
NO2	nitrite
NO3	nitrate
NPDES	National Pollutant Discharge Elimination System
NPW	non-potable water
O2	oxygen
ORP	oxygen reduction potential
OTE	oxygen transfer efficiency
P	phosphorus
PAO	phosphorus accumulating organisms
PE	population equivalent
PHF	peak hourly flow
PSLRP	Private Sewer Lateral Rehabilitation Program

LIST OF ABBREVIATIONS (CONTINUED)

ABBREVIATION	DESCRIPTION
POTW	Publically Owned Treatment Works
PVC	polyvinyl chloride
PWWF	peak wet weather flow
RAS	return activated sludge
RBC	rotating biological reactor
SCADA	Supervisory Control and Data Acquisition
sf	square feet
SOR	standard oxygen requirement
SOUR	specific oxygen uptake rate
sq	square
SS	suspended solids
SSES	Sanitary Sewer Evaluation Study
SSO	sanitary sewer overflow
SV	seasonal variation
TDH	total dynamic head
TMDL	total maximum daily load
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VFD	variable frequency drive
VSS	volatile suspended solids
WAS	waste activated sludge
WLA	waste load allocation
WQBEL	water quality based effluent limit
WWTP	wastewater treatment plant
yr	year

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

GENERAL

The Glenbard Wastewater Authority's Advanced Wastewater Treatment Facility is located in DuPage County, approximately 20 miles west of Chicago. The entire Facility Planning Area (FPA) is approximately 14,000 acres and encompasses portions of the Villages of Lombard and Glen Ellyn, a development served by Illinois American Water, and an area in unincorporated DuPage County (Glen Ellyn Heights). Wastewater generated within Facility Planning Area is treated at the Glenbard Wastewater Authority's Advanced Wastewater Treatment Facility (GAWTF), located on Bemis Road.

Current and future water usage and wastewater production was analyzed on the basis of "population equivalents" or PE which provides a common basis for assessment of residential and non-residential demands. The 2018 analysis utilized the 1977 population data and added the residential growth to those values from the Authority's tracking data for Glen Ellyn, Lombard, unincorporated DuPage County, and Illinois American Water. This growth and existing population resulted in a 2018 PE estimate of approximately 102,731. Based on the Chicago Metropolitan Agency for Planning (CMAP) projections the growth rate of the Authority's tributary communities was expected to be approximately 0.5% annually. This growth rate would result in an interpolated PE of approximately 114,372 in 2040.

The existing GAWTF is currently operating well within design loadings and has reserve capacity to serve the communities for more than 20 years. However, regulatory requirements on effluent water quality are changing, specifically in regards to nutrient removal. This change will require that new treatment processes are constructed and implemented to meet more stringent effluent limits on ammonia, phosphorus, and nitrogen.

FACILITY PLANNING

A Wastewater Facility Plan is a management and planning document used to identify, evaluate, and plan required wastewater facility improvements. The plan provides an assessment of the treatment system's abilities to meet both current and future flows, pollutant loads, and regulatory requirements. The plan also contains critical information for improvements necessary to correct current or projected deficiencies.

The Glenbard Wastewater Authority's last Facility Plan was prepared in 2013. It is now almost six years old. Since the 2013 update, the Authority has implemented several of the recommendations, however, in an effort to be proactive and plan for the future, the Authority is seeking to update the Facility Plan to develop a document which includes a Capital Improvements Plan to assist in budgeting for necessary improvements to meet current and pending effluent standards. This Facility Plan is generally organized in nine separate sections as follows:

- Section 1 – Introduction and Background
  Provides background information on the facility and outlines the purpose of Facility Planning
- Section 2 – Community Needs
  Reviews the current loading to the facility, and anticipated future loading to ensure capacity

- Section 3 – Interceptor Sewers & Lift Stations
  Evaluates both the existing interceptor sewers and lift station capacities and their remaining service lives
- Section 4 – Combined Sewer Overflow (CSO) Facility
  Evaluates each unit process within the CSO facility and identifies alternatives for rehabilitation
- Section 5 – Existing Wastewater Treatment Facility
  Evaluates each unit process within the wastewater facility and identifies alternatives for rehabilitation
- Section 6 – Odor Control
  Reviews the existing treatment facility and identifies short and long-term odor control strategies
- Section 7 – Regulatory Requirements & Upgrades
  Reviews the future regulation implications to the facility, and develops/identifies projects for future regulatory compliance
- Section 8 – Environmental Impacts
  Reviews the environmental implications to improvements including watershed impacts
- Section 9 – Capital Improvements Plan (CIP)
  Summarizes all identified projects required, Identifies the required annual investment for capital projects and provides implementation schedules

WASTEWATER TREATMENT FACILITY

The Glenbard Advanced Wastewater Treatment Facility was originally constructed in 1977 as an expansion to the existing plant owned by Glen Ellyn. The facility has been incrementally expanded and rehabilitated over the past 41 years, and as such much of the plant buildings and equipment date back to this period. In general, concrete structures have a service life of up to 75 years, however equipment varies depending on use, maintenance, and manufacturer. High-speed equipment such as pumps can be expected to provide 12-15 years of service life, and low-speed process equipment such as screens and belt presses provide 20-25 years. These are diminished in corrosive or abrasive applications such as raw sewage handling or grit removal.

A significant amount of the equipment at the GAWTF has reached or has exceeded its respective service life. Diligent maintenance and operation have provided the Authority with exceptional equipment longevity, however several major systems will require replacement within the next 10 years. This includes the primary clarifiers, biological process, intermediate clarifiers and pump station, final clarifiers, and dewatering systems. The bulk of this equipment was installed in the 1977 expansion and is due for replacement.

REHABILITATION & UPGRADE RECOMMENDATIONS

Recommendations for GAWTF rehabilitation and replacement have been separated into two groups; those budgeted for in-house annual replacement/rehabilitation, and larger Capital Improvements Projects.

In-House Annual Rehabilitation/Replacement

A condition assessment for each piece of major equipment within the Wastewater Treatment Facility was completed. Items which are not scheduled for replacement within a major capital improvement project were prioritized for replacement over the next 10 years, to be financed through the annual operating budget. The condition assessment tables are provided in Appendix D, organized by plant process. With an annual funding allotment of approximately $300,000-$600,000 per year for equipment replacement was prioritized beginning in FY2020 as follows:

CY2020: RAS Pump Station Rehabilitation	($180,000)
CY2021: Grit Pump & Screening Washer/Conveyor Replacement	($310,000)
CY2022: Gravity Sludge Thickener Rehabilitation	($560,000)
CY2023: Carbo RAS Pump Replacement	($240,000)
CY2024: RAS Mag Meter Replacement	($60,000)
CY2025: Grit Washer #1 and Meter Replacement	($225,000)
CY2026: Grit Washer #2 and Effluent Meter Replacement	($225,000)
CY2027: Carbo RAS Meter & RAS VFD Replacement	($210,000)
CY2028: Grit Removal Chamber #1 Replacement	($225,000)
CY2029: Grit Removal Chamber #2 & Blower Replacement	($345,000)

**Each year there is an anticipated additional $100,000 to be spent on the Unox Deck for replacement of motors, drives, mixers, etc. over the next ten years.*

Capital Improvements Projects

Twelve capital projects have been identified for completion within the 10-year capital improvements program. As previously discussed, the majority of the GAWTF was constructed in 1977 and as such the equipment installed in this era has reached the end of their useful service lives. The Authority will need to plan for replacement of a number of major processes over the next 10-15 years. In addition, regulatory requirements for phosphorus and nitrogen removal will necessitate major improvements to the biological process unrelated to rehabilitation. In process order, the capital projects identified include:

Project	Construction Subtotal w/ 15% Contingency	Engineering, Legal & Admin @ 15%	Total
1. Primary Clarifier Rehabilitation:	$1,778,000	$267,000	$2,045,000
2. Grit/Primary Clarifier Odor Control (Phase 1):	$384,000	$60,000	$444,000
3. Grit/Primary Clarifier Odor Control (Phase 2):	$992,000	$149,000	$1,141,000
4. Sludge Thickening Odor Control (Phase 1):	$303,000	$45,000	$348,000
5. Sludge Thickening Odor Control (Phase 2):	$1,100,000	$159,000	$1,259,000
6. Electronic O&M Manuals:	N/A	$380,000	$380,000
7. Sludge Dewatering Rehabilitation:	$1,900,000	$280,000	$2,180,000
8. Intermediate Pumping Station Rehabilitation:	$1,600,000	$242,000	$1,842,000
9. Intermediate Clarifier Rehabilitation:	$1,010,000	$162,000	$1,172,000
10. Chemical Phosphorus Removal (1.0 mg/L):	$2,000,000	$293,000	$2,293,000
11. Final Clarifier Rehabilitation:	$4,200,000	$625,000	$4,825,000
12. CSO Facility Upgrades:	$2,010,000	$308,000	$2,308,000
		Total Capital Projects:	**$20,237,000**

Each of these projects, as well as alternatives evaluated, are described in detail in the respective unit process reviews within Section 5. Detailed cost estimates including scope of work to be completed are included in Appendix E.

IMPLEMENTATION PLAN

The implementation schedule for capital improvements is driven by both urgency of rehabilitation needs, and regulatory requirements imposed by the Illinois EPA. The following table outlines the recommended schedule for both the annual rehabilitation/replacement program, as well as the capital improvements projects.

	Implementation Plan ($ in Millions)										
Project Description	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029(1)	Project Total
Primary Clarifier Rehabilitation	2.10										**2.10**
Grit Building/Primary Clarifier Odor Control (Phase 1)		0.45									**0.45**
Grit Building/Primary Clarifier Odor Control (Phase 2)			1.20								**1.20**
Sludge Thickening Odor Control (Phase 1)		0.35									**0.35**
Sludge Thickening Odor Control (Phase 2)			1.22								**1.22**
Electronic O&M Manuals				0.38							**0.38**
Sludge Dewatering Rehabilitation		2.20									**2.20**
Intermediate Pumping Station Rehabilitation					1.90						**1.90**
Intermediate Clarifier Rehabilitation						1.20					**1.20**
Chemical Phosphorus Removal (1.0 mg/L)				2.30							**2.30**
Final Clarifier Rehabilitation							4.80				**4.80**
CSO Facility Upgrades								2.30			**2.30**
Various Small-Scale (From Condition Assessment Table)	0.30	0.42	0.63	0.31	0.13	0.30	0.30	0.32	0.33	0.45	**3.48**
PLC Replacement Projects	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	**1.30**
MCC Replacement Projects	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	**1.40**
Annual Collection System Rehabilitation Funding	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	**3.00**
Annual Lift Station Rehabilitation Funding	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	**2.30**
Calendar Year Total:	**3.20**	**4.22**	**3.85**	**3.79**	**2.83**	**2.30**	**5.90**	**3.42**	**1.13**	**1.25**	***31.88***
	(1): Future Capital Project for TN Removal (Estimated at $27.7 Million - 2018 dollars) Est. Year 2030-2035										

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SECTION 1
INTRODUCTION AND BACKGROUND

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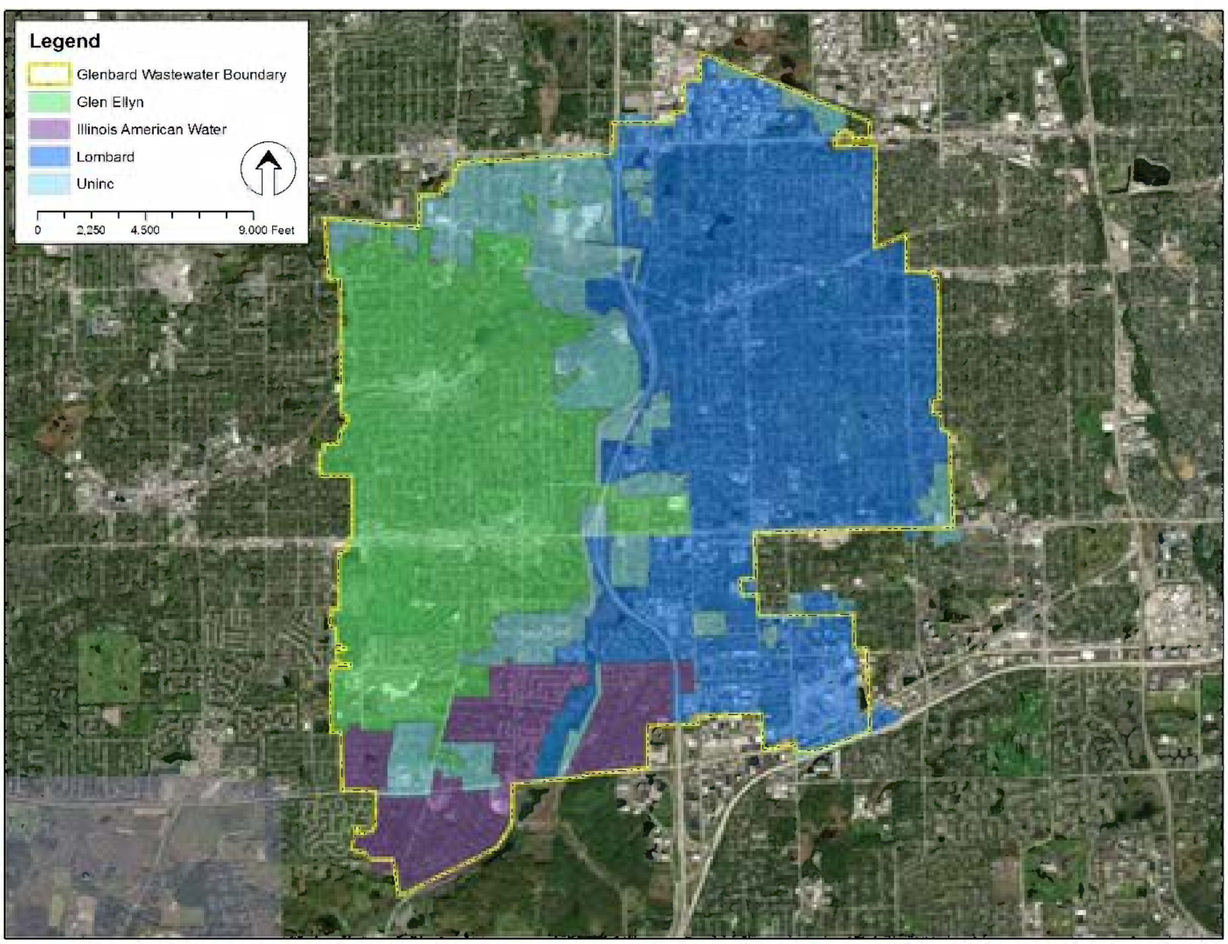
1. INTRODUCTION AND BACKGROUND

1.1 GENERAL BACKGROUND

The Glenbard Wastewater Authority (GWA) was formed in 1977 when the Villages of Lombard and Glen Ellyn entered into an intergovernmental agreement for the purpose of providing wastewater conveyance and treatment for both communities.

The Glenbard Facility Planning Area (FPA) includes approximately 14,000 acres, as shown in the exhibit below. There are four entities which are tributary to the Glenbard Advanced Wastewater Treatment Facility (GAWTF), including the Villages of Lombard and Glen Ellyn, a development served by Illinois American Water, and an area in unincorporated DuPage County (Glen Ellyn Heights). The Authority currently serves approximately 103,000 Population Equivalents (P.E.), and the most recent population projection for the build-out of the Glenbard Facility Planning Area (FPA) is approximately 114,000 P.E, which is anticipated to occur in the year 2040.



The Authority maintains five regional lift stations, interceptor sewers, a main wastewater treatment facility, and an excess flow treatment plant. The regional lift stations include the St. Charles Road Lift Station, the Valley View Lift Station, the SRI Lift Station, and the Sunnyside Lift Station. A fifth lift station, Hill Avenue, is part of the Lombard Combined Sewage Treatment Facility (LCSTF).

GWA has two main interceptor sewers, the North Regional Interceptor Sewer and the South Regional Interceptor Sewer. Both interceptor sewers are tributary to the Main WWTF under normal flow conditions. During heavy rain events and as flows increase to the North Regional Interceptor Sewer, the hydraulic grade starts to increase within the sewer. As the hydraulic grade increases, the diversion structure near the LCSTF will automatically divert a portion of the flows to the facility. The flows can increase rather quickly due to large extent of the Village of Lombard's combined sanitary and storm sewer system that is tributary to the NRI.

The Main WWTF is located at 945 Bemis Road in Glen Ellyn and was originally constructed in the early 1930's. The facility was majorly overhauled in 1977, including installation of many treatment processes that are still in use today. Over the years several projects have replaced or modified portions of the WWTF. The facility is rated for 16.02 MGD Design Average Flow and a 47.0 MGD Design Maximum Flow. The excess flow LCSTF is located at 625 W. Glen Oak Road in Lombard. This facility treats excess flow up to 58.0 MGD from the Village of Lombard's combined sanitary and storm sewer system. Flow exceeding 58.0 MGD is diverted to two lagoons, which have a design capacity of 14.5 MGD. Both facilities provide wastewater treatment and ultimately discharge to the East Branch of the DuPage River.

1.2 PURPOSE AND SCOPE

1.2.1 Facility Plan

A Wastewater Facility Plan (or Master Plan) is a management and planning document used to identify, evaluate, and plan required wastewater facility improvements. The plan provides an assessment of the collection and treatment system's abilities to meet both current and future flows, pollutant loads, and regulatory requirements. The plan also contains critical information for improvements necessary to correct current or projected deficiencies.

Facility Plans are required by the Illinois EPA for any wastewater improvements that change the treatment process or expand the capacity of the wastewater treatment plant. They are typically updated every five to ten years or when planning conditions change or otherwise warrant, such as when significant changes in growth projections or regulatory requirements have occurred or are expected.

The GWA's most recent Wastewater Facility Plan was prepared in 2013 and is now five years old. Since the 2013 update, the Authority has implemented several of the recommendations including a raw sewage pumping rehabilitation, conversion from sand to disc filters, upgrades to site utilities, and a new Combined Heat and Power system. However, in an effort to be proactive, the Authority is seeking to update the Facility Plan to develop a single document which includes a Capital Improvements Plan to assist in budgeting for necessary improvements to meet new and pending effluent standards.

In order to receive Low Interest Loan Funding for capital improvements, the Illinois EPA requires a Facility Plan update to be completed every five years to address aging infrastructure, capacity needs and pending regulatory changes.

The purpose of this Wastewater Facility Plan is to:

- Evaluate the adequacy of the existing collection and treatment facilities under the current flows, loads and regulatory requirements;
- Review the maintenance history and current condition of wastewater treatment units and lift stations, as well as identify any required maintenance repairs/replacements that are necessary;
- Estimate the additional flows and loads associated with future growth within the planning area during the 20-year planning period;
- Summarize pending and potential future environmental regulations related to wastewater conveyance and treatment;
- Determine the impacts of future flows, loads and regulatory requirements on the existing systems;
- Identify and evaluate feasible alternatives to address both current and future deficiencies;
- Identify other projects to improve the efficiency of and effectiveness of system operation;
- Recommend cost effective solutions;
- Assess environmental impacts of the recommended plan; and
- Present an Implementation Plan for the recommended improvements.

1.2.2 Pending Regulatory Requirements

As discussed, one of the primary drivers for completion of a Facility Plan are regulatory updates or requirements instituted by the US EPA, Illinois EPA, or other governing bodies. This report will review the relevant regulatory changes on the horizon which may impact the Glenbard Wastewater Authority. The Authority's WWTF discharges to the East Branch of the DuPage River and ultimately to the DuPage River. According to the Illinois EPA Clean Water Act Section 303(d) List, the DuPage River does not meet water quality standards for its intended use in the majority of the segments. The DuPage River is impaired for aquatic life based on low D.O. and high phosphorous concentrations.

This low dissolved oxygen content is due in part to algal growth and exacerbated by the presence of pools upstream of the low head dams along the river. The increased algal growth can be attributed to elevated nutrient (specifically nitrogen and phosphorus) levels in the water. Algae will grow in water until nutrients have been depleted. In most waterways, there is an abundance of nitrogen when compared to phosphorus. Phosphorus, a naturally occurring element, is typically the limiting nutrient in algal blooms. Elevated dissolved phosphorus concentrations are due to a combination of both non-point sources, such as agricultural runoff, and point sources, such as WWTF effluent.

In 2005, many of the communities along the DuPage River (including the Authority) joined with other stakeholders, including Friends of the Fox and Sierra Club, to form the DuPage River Salt Creek Workgroup (DRSCW). This group was formed in response to concerns about the East and West Branch DuPage River TMDLs and Salt Creek TMDL. The goal of the DRSCW is to better determine the stressors to the aquatic system through long term water quality monitoring and to develop and implement remediation projects. The DRSCW is working with the Illinois EPA to issue NPDES permits that will help achieve their goal of improving the water quality within the watershed.

The Authority received an updated NPDES permit (IL0021547) effective on September 23rd, 2015. This permit includes Special Condition 17, which requires the preparation of the Phosphorus Removal Feasibility Study. This requires the Authority to comply with a 1.0 mg/L phosphorus limit within either 10 or 11 years from the effective permit date (based on the type of technology implemented). The special condition include language that requires the submittal of a Feasibility Study reviewing the viability and costs of lowering the annual average effluent phosphorus concentration to 1.0 mg/L, 0.5 mg/L and 0.1 mg/L. A Phosphorus Removal Feasibility Study was completed in several different phases and memos, ultimately submitted in September 2017. Findings from this report have been integrated within Section 7 of this Facility Plan.

The purpose of this study was to:

- Review the NPDES permit issued to the Glenbard Wastewater Authority WWTF;
- Review and summarize the previously proposed chemical and biological phosphorus removal alternatives for achieving annual, monthly, and seasonal average effluent total phosphorus (TP) limits of 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L, respectively; and
- Summarize the costs to implement and operate the selected alternative(s).

SECTION 2
COMMUNITY NEEDS

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2. COMMUNITY NEEDS

2.1 INTRODUCTION

This section includes a discussion of the Authority's planning area, current and future population equivalents, wastewater flows, pollutant loadings, and regulatory requirements in order to provide a complete evaluation of the Authority's wastewater conveyance and treatment needs.

2.2 GENERAL BACKGROUND

The Glenbard Wastewater Authority is located in DuPage County, approximately 20 miles west of Chicago. The Facility Planning Area (FPA) is comprised of several communities including The Village of Glen Ellyn, The Village of Lombard, and Unincorporated DuPage County. The entire planning area is about 14,000 acres. Wastewater generated within the FPA is treated at the Glenbard Advanced Wastewater Treatment Facility (GAWTF), located on Bemis Road, in Glen Ellyn.

Village of Glen Ellyn

The Village of Glen Ellyn comprises the western portion of the facility planning area and contains the primary campus of College of DuPage. The Village has an area of approximately 4,300 acres. The Village of Glen Ellyn represents approximately 28% of the total FPA area.

Village of Lombard

The Village of Lombard covers the eastern portion of the FPA and contains the Yorktown Shopping Center. In total, the Village of Lombard is comprised of approximately 6,350 acres. The Village of Lombard represents approximately 41% of the total FPA area.

Illinois American Water

Illinois American Water provides service within the FPA boundary of the Glenbard Wastewater Authority and is approximately 1,300 acres in size. The service area is in the south portion of the FPA and is split on both sides of the East Branch of the DuPage River. Illinois American Water represents approximately 8% of the FPA.

Unincorporated DuPage County

The remaining area (23%) is unincorporated DuPage County. This area is primarily comprised of residential developments and small pockets of open space/golf courses.

2.3 EXISTING CONDITIONS

2.3.1 Current Population Equivalents (PE)

Current and future water usage and wastewater production was analyzed on the basis of "population equivalents" or PE which provides a common basis for assessment of residential and non-residential demands. One PE is equivalent to the wastewater produced by one resident, as determined by historic data. In addition to the review of water use data, historical planning documents were reviewed to identify where previous quantities and calculations originated, and how they have changed over the years.

Historic Population Equivalent Estimates

Previous Facility Plans have defined the existing PE in the Facility Planning Area and the Ultimate Available PE in a variety of ways over the last four decades. The following sections identify how the existing and ultimate PE have altered as part of each planning document that was developed.

1977 Original Design Estimates

The original Facility Plan and design (1977) of the existing facility utilized an Ultimate Population Equivalent of 109,000 with a design year of 2000. At that time the projected PE was broken down as shown in Table 2-1. A tracking spreadsheet was developed to track all proposed and constructed developments within the Authority's FPA and has been updated continuously since the Authority's inception. Table 2-1 outlines a design population of 99,000 and only two sources of non-residential PE; College of DuPage and the Yorktown Shopping Center.

Table 2-1: 1977 Design Population Equivalents (PE)

2000 Design Population	99,000
College of DuPage	5,000
Yorktown Shopping Center	5,000
Total Design PE	109,000

1989 Long- Range Planning Study Estimates

In 1989, a Long-Range Planning Study analyzed existing population, as well as the land/zoning within the Facility Planning Area. The study reviewed the land that could be developed and determined an updated ultimate buildout PE for the FPA of 109,125. Since the issuance of the report, this value is still recognized as the Ultimate PE for the FPA. The calculation for this estimate is shown in Table 2-2.

Table 2-2: 1989 Existing Population Equivalents

Existing Population Equivalent	84,469
Additional Ultimate Residential Population	14,681
Ultimate Areal Non-Residential Buildout: $\dfrac{481\ \text{acres} * 2000\dfrac{\text{GPD}}{\text{acre}}}{96.4\dfrac{\text{GPC}}{\text{day}}}$	9,975
Total Population Equivalent	109,125

The estimate above uses an existing population equivalent value before adding expected ultimate residential population and areal buildout. This areal buildout provides a population equivalent value for all non-residential areas in the FPA that could be developed. When combined with the existing PE and the ultimate remaining residential population, this provides the basis for the total PE value. Future estimates accounted for non-residential PE based upon square footage of constructed facilities, rather than the acreage estimate used in 1989.

2006 Facility Plan Estimates

During the 2006 Facility Plan Update, GWA provided new PE estimates for analysis. The plan uses 2005 as the current year for all calculations performed. At that time, the Authority estimated that the current PE was 102,033 using growth from the Authority's PE tracking spreadsheet between the years 1976 and 2006 added onto the 1976 populations of Glen Ellyn and Lombard. The 2006 Facility Plan states that this method was subject to overestimates of the connected population, as it uses a value of 3.5 PE per household for all new single-family residences. Household size in the FPA has been found to be closer to 2.8 PE per single-family home. Table 2-3 was developed by GWA in 2006 using the original 3.5 PE per household, with a current PE projection of 102,033.

Table 2-3: 2006 Report PE Estimate

1976 Glen Ellyn and Lombard Residential Population	60,317
Glen Ellyn PE Growth 1976 to 2005 (Includes 2,088 for American Water and 1,233 for DuPage County)	14,586
Lombard PE Growth from 1976 to 2005	27,130
Total 2005 PE	102,033

As part of the 2006 Facility Plan an effort was made to obtain more accurate PE estimates for the unincorporated areas of DuPage County within the FPA. One of the tools utilized was the Northern Illinois Planning Commission (NIPC) which supplied additional data.

The NIPC analysis that was performed used a quarter section-level analysis of sections that included portions of the FPA to determine a population value. This area was then adjusted to exclude and remove portions of quarter sections that were outside of the FPA. From this adjusted NIPC value, the populations of Glen Ellyn and Lombard were subtracted to obtain the population of unincorporated sections. A 2030 population estimate was also developed as part of this method. The values identified by the NIPC are displayed in Table 2-4.

Table 2-4: NIPC PE Estimates - Unincorporated DuPage County

	2000	2030
Glen Ellyn	26,999*	32,291
Lombard	42,322*	50,618
Total (A)	69,321	82,909
NIPC Quarter Sections	88,497	96,752
NIPC Quarter Sections Adjusted (B)	83,772	90,402
Unincorporated Population (B-A)	14,451	7,493

**2010 Census*

The population included for Unincorporated DuPage County in the NIPC study was calculated as the difference between the 2000 Census populations of Glen Ellyn and Lombard, and the total adjusted quarter section population within the FPA. Population not located within Glen Ellyn or Lombard was counted as residing in Unincorporated DuPage County.

The 2006 Facility Plan includes an updated PE estimate using the data from the NIPC report, with 2005 as the current year and 2027 as the 20-year planning horizon. The ultimate PE for 2030 from NIPC were considered equivalent to the values for 2027, as ultimate buildout was predicted to occur before 2027. A straight-line estimate from the 2000 value from NIPC was used for Glen Ellyn. However, the Village of Lombard had completed a "Paint the Town" census, providing an updated population of 45,000.

Unincorporated populations were calculated with a straight-line estimate from the NIPC report values for 2000 and 2030 as shown below:

$$14{,}451 + \frac{(7{,}493 - 14{,}451) * 5\ years}{27\ years} = 13{,}200$$

Within the existing FPA, additional estimates were made for the College of DuPage and the Yorktown Shopping Center to calculate the total PE. Ten percent (10%) of the enrollment at the College was included in the PE estimate, as was fifteen percent (15%) of staff. Additionally, the Yorktown Shopping Center was estimated at 5,000 PE. For the 20-year planning period, the remainder of the Ultimate PE was attributed to "Unforeseen Commercial Development." Table 2-5 below displays the final 2005 and 2027 estimates from the 2006 Facility Plan.

$$College\ of\ DuPage\ Student\ PE = 30{,}000\ \times 0.10 = 3{,}000$$

$$College\ of\ DuPage\ Staff\ PE = 3{,}400\ \times 0.15 = 500$$

Table 2-5: 2005 and 2027 PE Estimates (2006 Facility Plan)

	Existing (2005)	Future (2027)
Glen Ellyn	28,000	32,291
Lombard	45,000	50,618
Unincorporated DuPage County	13,200	7,493
Population Subtotal	86,200	90,402
College of DuPage Students	3,000	3,600
College of DuPage Staff	500	600
Yorktown Shopping Center	5,000	5,000
PE Total	94,700	99,602
Unforeseen Commercial/Industrial	---	9,523
Total	94,700	109,125

The 2006 Report's summary of Population Equivalents concludes by stating that there are no large industrial dischargers in the GWA FPA and that there were no planned industrial developments. In addition, the main significant sources of nonresidential wastewater are identified as the College of DuPage and the Yorktown Shopping Center. Therefore, the 2006 Facility Plan projected the same 109,125 PE as the ultimate buildout value.

2013 Facility Planning Estimates

Moving forward, the 2013 Facility Planning Report revisited the PE estimates for the Authority. As part of that analysis, 2011 US Census estimates and Chicago Metropolitan Area for Planning (CMAP) data was used to calculate an existing PE and a 2033 design year projection. This report assumed that there was no change in population in unincorporated DuPage County territories between 2005 and 2011, and that the 2006 report's value for unincorporated population in 2027 would be equivalent to the 2033 population as buildout would have been reached. Estimates for College of DuPage and Yorktown Shopping Center Population Equivalents were considered to be unchanged from the 2006 report. Shown in Table 2-6 are the population projections from the 2013 report:

Table 2-6: 2013 Facility Plan PE Estimates

	Year 2005 (2006 FP)	Year 2027 (2006 FP)	Year 2011 Estimate (2013 FP)	Design Year 2033 (2013 FP)
Village of Glen Ellyn	28,000	32,291	27,648	35,872
Village of Lombard	45,000	50,618	43,462	55,161
Unincorporated Areas	13,200	7,493	13,200	7,493
College of DuPage	3,500	4,200	3,500	4,200
Yorktown Shopping Center	5,000	5,000	5,000	5,000
Unforeseen Commercial	---	9,523	---	1,399
Total Population Equivalent	94,700	109,125	92,810	109,125

2018 Population Equivalents Estimate

With an understanding of the historical Population Equivalent estimates for the Glenbard Wastewater Authority, and knowing how they have evolved over time, a new estimate was developed in order to more accurately analyze present loadings and prepare for forecasted flows. The Population Equivalent estimate for the 2018 Facility Plan was developed utilizing several different sources and included the growth development data provided from the Authority, as well as the 1977 population data from the original design.

The 1977 populations of Glen Ellyn and Lombard were used as a baseline, as these values were utilized during the design of the wastewater treatment plant. These values identified the existing population base without any commercial/industrial usage. Over the last four decades, the Authority has performed extensive tracking identifying all development of new parcels, as well as redevelopment of existing areas for both residential and commercial properties.

The 2018 analysis utilized the 1977 population data and added the residential growth to those values from the Authority's tracking data for Glen Ellyn, Lombard, unincorporated DuPage County, and Illinois American Water. The data that was provided from the PE tracking spreadsheet was separated out into Commercial and Residential growth, and can be identified in Table 2-7 and Table 2-8. This spreadsheet uses a population per single family household value of 3.5.

Table 2-7: Residential Growth 1976-2018

1976 Facility Design Population	60,317
Glen Ellyn Residential Growth	7,956
Lombard Residential Growth	19,657
Unincorporated DuPage Residential Growth	1,343
Illinois American Water Residential Growth	2,086
Total Residential PE	91,359

Table 2-8:Commercial/Industrial Growth 1976-2018

Glen Ellyn Commercial/Industrial Growth	4,068
Lombard Commercial/Industrial Growth	11,981
Unincorporated DuPage County Commercial/Industrial Growth	203
Illinois American Water Commercial/Industrial Growth	125
Total Non-Residential PE	16,377

Previous calculations of PE only took into consideration the population and minor pieces of the commercial/industrial base. Therefore, the PE tracking information that was provided by the Authority was critical into developing a more accurate estimate that also includes non-residential growth in the FPA. Adding these values together, the 2018 PE is estimated at 107,736 as shown in Table 2-9.

Table 2-9: 2018 Population Equivalent

1976 Facility Design Population	60,317
Glen Ellyn PE Growth *	12,024
Lombard PE Growth *	31,638
Unincorporated DuPage County Growth*	1,546
Illinois American Water Growth 1976 to 2018 *	2,211
Total Existing PE	107,736

*Sum from Table 2-7 and Table 2-8

As stated previously in this report, the estimate of 3.5 PE/household is believed to be an overestimate of the actual conditions within the FPA. An estimate of 2.8 PE per single-family household was found to be more accurate. Decreasing the single-family dwelling value for growth since 1976 would result in a total existing PE of 102,731.

Table 2-10: 2018 Population Equivalent Estimate

1976 Facility Design Population	60,317
Glen Ellyn PE Growth *	11,271
Lombard PE Growth *	27,665
Unincorporated DuPage County Growth*	1,459
Illinois American Water Growth 1976 to 2018 *	2,019
Total Existing PE	102,731

2.3.2 Current Influent Flows and Loading

The influent flow to the Authority remained relatively constant from 2013 through 2017, but there was an increase in 2014. BOD and TSS loading increased greatly in 2017. This also corresponded with a large increase in rainfall.

Table 2-11: Wastewater Flows and Loading (2013 – 2018)

Year	Average Flow (MGD)	% Change in Flow from 2013	Total Rainfall (Inch)	% Increase Rainfall	BOD_5 (mg/L)	TSS (mg/L)
2013	12.43	-	48.77	-	174	195
2014	13.44	8%	44.50	-9%	165	195
2015	12.92	-4%	40.11	-10%	160	209
2016	12.49	-3%	41.92	5%	166	198
2017	12.74	2%	50.12	20%	196	273
2018	13.11	3%	-	-	168	206
Avg 13-17	12.80	-	45.08	-	172	214

2.3.3 Infiltration

The USEPA considers average annual infiltration to be excessive if it exceeds 50 gallons per capita per day (GCD). The current estimated population equivalent within GWA's service area is 107,736 PE. This value, using 3.5 PE per single family home, was used in order to conservatively estimate loadings to the WWTP. The average water usage per population equivalent was calculated by utilizing the average of the last three year's low flows as shown in Table 2-11. Based on that information the average water usage per population equivalent is 83 GCD. The average amount of infiltration was estimated by comparing the FPA PE with the plant influent records for the last three years. The average wastewater received per population equivalent is 118 GCD. The annual average I/I is approximately 35 GCD. The USEPA defines excessive infiltration as exceeding 50 GCD, and as such this is not considered excessive. Infiltration will be further discussed in Section 3.

Table 2-12: Three Month Low Flows

Year	Three Month Low Flow (MGD)	Months	Three Month Low Flow Average (MGD)
2015	8.44	October	9.27
	9.39	February	
	9.97	January	
2016	9.00	September	9.83
	9.77	November	
	10.72	July	
2017	7.35	September	7.76
	7.89	August	
	8.04	December	
2018	9.03	July	9.76
	9.77	August	
	10.49	January	

2.3.4 Inflow

The design maximum flow of the treatment plant is 47.0 MGD, or 2.93 times the average daily flow. The USEPA considers inflow to be excessive in separate sanitary sewer systems if the total flow (water usage plus infiltration plus inflow) exceeds 275 GCD. In the past three years the maximum influent to the plant was 35.8 MGD, which occurred on June 16, 2015 following a heavy rainfall event. This equates to a flow of 332 GCD, with 297 GCD potentially attributed to inflow. This is above the USEPA standards which designate excessive inflow. Additionally, hourly peak flow rates have previously exceeded this level and have reached as high as 47.0 MGD, the plant's design maximum capacity. This will be further discussed in Section 3.

Influent pollutant loading was determined to be approximately 0.14 lbs. BOD_5/day/PE and 0.16 lbs. TSS/day/PE. These values are typical of a predominantly domestic wastewater and slightly lower than those that would be required by the IEPA in the absence of this historical data. Table 2-13 compares the current low flow influent wastewater flows and pollutant loads to the existing treatment plant's design ratings. Future PE projections will be analyzed in this section to determine capacity requirements of the treatment plant at build-out throughout the Glenbard Wastewater Authority's FPA. In order to not exceed critical review limits, the facility should maintain low flows and loadings below 80% of design capacities. The three-month low flow values show that the facility is 57% hydraulically loaded and 48% organically loaded.

Table 2-13: WWTP Low Flows and Loadings versus Design

Parameter	Flow (MGD)	BOD_5 (lbs/day)	TSS (lbs/day)
Design Condition	16.02	27,256	32,066
Current Low Flow Condition	9.17	13,144	16,274
Current Loading (% of Design)	**57%**	**48%**	**51%**

The Glenbard Wastewater Authority's WWTP is currently operating well within design ratings on a low flow basis, and well below the critical review limits. The existing plant has reserve capacity to serve the Authority for nearly 20 years as will be discussed in the following subsections. However, regulatory requirements on effluent water quality could change, specifically in regards to nutrient removal. This change will require that new treatment processes are constructed and implemented to meet more stringent effluent limits on ammonia, phosphorus, and nitrogen.

2.4 FUTURE CONDITIONS

The population within the FPA of the Authority has stayed relatively consistent over the last few years. However, according to the Chicago Metropolitan Agency for Planning (CMAP), the population of DuPage County is anticipated to increase by 22% from 2010 to 2040 (see Exhibit 2-1). Similarly, the CMAP projections for the Village of Lombard, and Village of Glen Ellyn is a little more conservative and is forecasted at approximately 0.5% growth annually. While this may seem unlikely when compared to historical population trends, the anticipated growth should be considered when planning for ultimate capacity of public works infrastructure, as it provides a more conservative approach.

Exhibit 2-1: CMAP Population Growth Predictions

	Population in Households				Households				Employment			
	2010	2040	CHANGE	GROWTH	2010	2040	CHANGE	GROWTH	2010	2040	CHANGE	GROWTH
Cook	5,104,393	5,960,242	855,849	16.8%	1,966,356	2,304,045	337,689	17.2%	2,379,923	2,814,972	435,049	18.3%
DuPage	904,784	1,104,089	199,305	22.0%	337,132	412,100	74,968	22.2%	608,709	768,282	159,573	26.2%
Kane	508,482	789,295	280,813	55.2%	170,479	265,774	95,295	55.9%	186,768	340,509	153,741	82.3%
Kendall	114,528	228,530	114,002	99.5%	38,022	74,382	36,360	95.6%	22,066	71,830	49,764	225.5%
Lake	682,753	896,341	213,588	31.3%	241,712	318,170	76,458	31.6%	314,717	401,748	87,031	27.7%
McHenry	307,113	508,918	201,805	65.7%	109,199	179,215	70,016	64.1%	88,947	153,389	64,442	72.4%
Will	669,013	1,175,218	506,205	75.7%	225,256	393,148	167,892	74.5%	201,854	437,110	235,256	116.5%
REGION	*8,291,066*	*10,662,633*	*2,371,567*	*28.6%*	*3,088,156*	*3,946,835*	*858,679*	*27.8%*	*3,802,984*	*4,987,839*	*1,184,855*	*31.2%*
Chicago*	2,654,078	3,054,654	400,576	15.1%	1,052,891	1,220,388	167,497	15.9%	1,221,758	1,458,527	236,769	19.4%

**Includes O'Hare portion in DuPage Co.*

**Sources: U.S. Bureau of the Census (2010 Population & Households); Illinois Department of Employment Security (2010 Employment); CMAP (2040 Projections)*

In addition to the anticipated growth from CMAP, the Village of Lombard's Planning Commission frequently meets and updates its tracking of current and proposed projects. As part of this update there have been a few projects that have been identified as non-residential development, and total approximately 186 PE. The Village of Glen Ellyn track proposed projects in a similar manner through GIS and have identified a total of 860 PE to be added to the service area, 370 PE for residential and 490 PE for Non-Residential. Review of land use and zoning within the FPA indicates that residential development will solely consist of re-development, and that these parcels are likely already served by the GWA. As such, only the non-residential planned developments were considered for future estimates.

Based on this information, the residential population is anticipated to increase from approximately 91,359 to 101,954 people in the FPA by 2040. In general, the Authority's FPA is primarily built out, with the only room for non-residential growth to be either redevelopment or vertical growth.

Taking into consideration the additional PE identified from each community, as well as the CMAP 2040 projections, the **expected PE in 2040 is 119,377.**

Table 2-14: Future PE Projections (2040)

Population Type	PE
Additional Future Residential PE	10,965
Additional Future Non-Residential PE	676
Total Additional Future PE	11,641
Current PE	107,736
Total Anticipated 2040 PE	**119,377**

This value is the conservative estimate that will be used for determining if the existing facility treatment capacity is sufficient. It is consistent with a 3.5 PE/single-family household estimate. As previously stated, an estimate of 2.8 PE/single-family household may represent existing conditions in the FPA more accurately. Projected growth will not be impacted by using the lower single-family household estimate, as these figures are calculated based upon CMAP projections. Table 2-15 below shows a recalculation of the 2040 PE using the 2.8 PE/home value.

Table 2-15: Future PE with 2.8 PE/Household

Population Type	PE
Additional Future Residential PE	10,965
Additional Future Non-Residential PE	676
Total Additional Future PE	11,641
Current PE	102,731
Total Anticipated 2040 PE	**114,372**

2.4.1 Future Capacity Requirements

As this population equivalent value is higher than previous estimates throughout the life of the WWTP, it is important to consider the viability of the existing facility to handle future loads. Table 2-16 was developed to analyze future low flow loadings at the WWTP in comparison to the design conditions. With a population equivalent value of 119,377 and a per capita daily water usage of 83 gallons.

The BOD loading, TSS loading, and three-month low flow values are all below 80% of the design values for the facility, indicating that the Authority would not be placed on Critical Review according to JCAR regulations. The capacity of the facility should be reviewed again during the next planning period.

Table 2-16: Future WWTP Flows and Loadings versus Design

Parameter	Flow (MGD)	BOD_5 (lbs/day)	TSS (lbs/day)
Design Condition	16.02	27,256	32,066
Future Low Flow Condition	10.82	19,760	24,522
Future Loading (% of Design)	**68%**	**57%**	**60%**

2.5 Regulatory Considerations

This Wastewater Facility Plan report addresses not only the Glenbard Wastewater Authority's current and future wastewater treatment needs in regards to growth, but also addresses future regulatory issues.

The required effluent quality for the Authority's wastewater treatment facility is dictated by its National Pollutant Discharge Elimination System (NPDES) permit. The wastewater treatment facility currently produces effluent having pollutant concentrations within those allowed by its NPDES permit. Water quality and compliance with NPDES permits will be discussed in further detail in Sections 4 and 5 of this report.

Future permits will also include limits on effluent concentrations of total nitrogen and more stringent limitations on phosphorus, as well as various other parameters. Section 6 of this report includes an analysis of alternatives and provides solutions to meet these regulatory challenges. An implementation plan for all these improvements is discussed in Section 8.

The plant is currently not designed for optimal nutrient removal. A phosphorus removal feasibility study and phosphorus discharge optimization plan were previously completed prior to the Facility Plan. Section 6 of this report summarizes the results of those studies, and provides an ultimate recommendation for the future upgrades to the existing wastewater treatment facility.

SECTION 3
INTERCEPTOR SEWERS

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3. INTERCEPTOR SEWERS

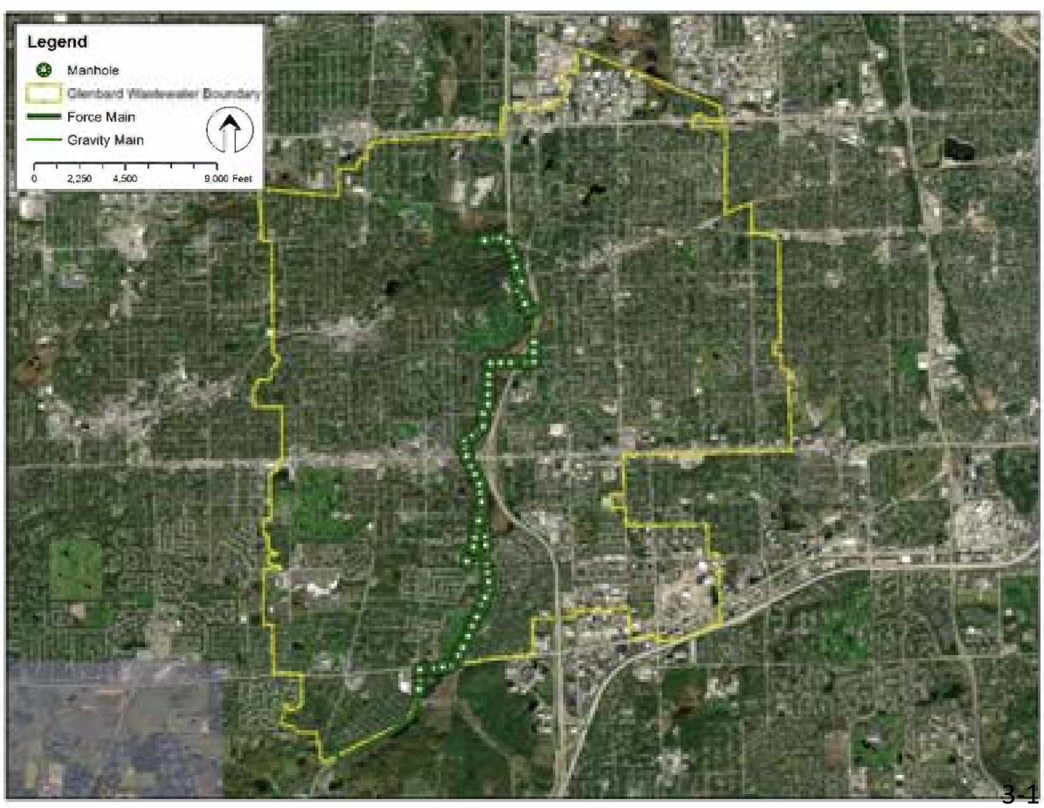
This section describes current conditions within the interceptor sewers, including deficiencies and maintenance issues. A discussion of inflow and infiltration (I/I) is presented. The impact on the existing infrastructure of additional flows from future development is also evaluated and recommendations are provided for capacity improvements and ongoing system maintenance, including performance of an Sanitary Sewer Evaluation Study (SSES) and recommendations to the existing Capacity, Management, Operation and Maintenance (CMOM) Program.

3.1 BACKGROUND

The Glenbard Wastewater Authority accepts flows from collection systems owned by the Village of Lombard and Village of Glen Ellyn, as well as systems owned by Illinois American Water, and areas serving unincorporated DuPage County. The GWA also owns and operates 32,590 feet of gravity sewer, 8,123 feet of force main, and which in total equates to 7.71 miles between the two, and five sewage lift stations. The pumping stations are Hill Avenue, South Regional Interceptor, St. Charles Road, Sunny Side, and Valley View. The Authority utilizes two large-diameter "interceptor" sewers, the North Regional Interceptor (NRI) and South Regional Interceptor (SRI) to convey wastewater flow from these independent collection systems to the main treatment facility.

Flow into the NRI is limited to 2.5 times the dry weather flow, with excess flow then diverted to the CSO Facility using vortex flow regulators. Because Hill Avenue is a CSO Stormwater Facility during wet-weather conditions, it is not included in the category of pumping stations that the GWA operates and maintains.

Exhibit 3-1: GWA Interceptor System



3.1.1 GWA Interceptor Pipe Material and Size

As technology and construction techniques have progressed over the years, different materials have been used to construct collection systems. As shown in Table 3-1, the Authority's GIS data has been sorted to identify the percentage of each material used in the collection system construction. This information can be used to help identify the age of the interceptor sewers and identify critical areas for repair or replacement.

Table 3-1: Sanitary Sewers by Material

Sewer Material	Length (ft)	Length (Miles)	% of System
CL	1,496	0.28	5%
DIP	183	0.03	>1%
PCCP	28,892	5.47	89%
PVC	1,627	0.31	5%
RCP	390	0.07	1%
Total	32,590	6.17	100%

As shown in Table 3-1, prestressed concrete cylinder pipe (PCCP) can be found in a large portion of the existing collection system (89%). PCCP is typically cast in longer sections (10-foot lengths) compared to older clay pipe that was typically constructed in two-foot lengths without leak free joints. PCCP typically was constructed with a water-tight rubber-gasket bell and spigot joints. Due to this type of construction and installation, PCCP could potentially help keep I/I under control within the collection system if it is still in good condition.

Typically, sewers within most of the newer neighborhoods and subdivisions are constructed of modern corrosion-resistant PVC sewer pipe. PVC is highly resistant to the corrosive sulfuric acids that form on the moist pipe walls in the presence of hydrogen sulfide sewer gases. PVC is the second most prevalent pipe material found within the Authority's collection system, and should also help minimize the amount of I/I and overall O&M.

The third most predominant pipe material found within the collection system is clay pipe, typically located in older areas of the FPA. However, it is a relatively small portion of the system (5%). Clay pipe was primarily constructed in 2-foot increments. There have been previous reports of large amounts of I/I and clay pipe could be a major contributing factor to this issue. Clay pipe was typically constructed in short segments without leak free joints and gaskets.

Due to the greater number of joints in clay piping and the relatively poor integrity of the pipe joints, I/I is typically prevalent in areas with this construction material. While it was acknowledged in the early years of sewer construction that some groundwater infiltration and inflow was considered beneficial to flush and clean the sewers, infiltration of groundwater into the collection system has become a serious concern as the infrastructure has aged and deteriorated.

In the last decade, the Authority has recognized the need to start rehabilitating portions of the collection system due to age and condition. However, due to the nature of the system (large diameter and depth) different methods outside of common practice of pipe replacement were required. The Authority implemented cured-in-place pipe (CIPP) program and has lined a small section of the collection system. Table 3-2 identifies the size of sewer lined and the total quantity. To date the Authority has lined approximately 9% of the system. CIPP lining is an effective alternative to full replacement of sanitary sewer pipes. The lining product can provide the required structural integrity, as well as remove infiltration from locations of bad joints. This program coupled with joint grouting, and the use of pipe end seals can make a drastic impact on a collection systems I/I.

Table 3-2: Sewer Lining

Sewer Lining (Size)	Length (ft)	Length (Miles)	% of System
18	2,940.69	0.56	9.02%

Table 3-3 below illustrates the percentage of the collection system based on pipe size. Most of the lines are large with approximately 94% of the lines being larger than 12 inches in diameter. Relative to age, about 94% of the lines are 40 years old. The sanitary sewer mains that are tributary to the Authority are not limited to the 6.17 miles that are maintained by GWA. There is an additional 277 miles of sewer lines that are owned by municipalities that are connected to the Authorities interceptors, and some of these areas contain combined sewers which drastically impact the I/I.

Table 3-3: Sanitary Sewer Size

Sewer Size (in)	Length (ft)	Length (Miles)	% of System
8	2,017.82	0.38	6%
10	15.00	0.00	0%
18	3,974.11	0.75	12%
24	2,115.42	0.40	6%
27	3,338.43	0.63	10%
30	3,295.74	0.62	10%
36	1,063.68	0.20	3%
48	1,244.58	0.24	4%
60	10,079.66	1.91	31%
66	5,445.71	1.03	17%
Total	32,590.12	6.17	100%

As previously discussed, the Authority currently maintains 6.17 miles of sanitary sewer mains (excluding force mains), as well as approximately 96 sanitary manholes. Using pipe sizing data provided by the Authority, it is estimated that the replacement value of the collection system is $18.3 Million in 2018 dollars, as shown in Table 3-5 on the following page.

Table 3-4: Sanitary Sewer Pipe Installed Cost per Foot

Sewer Size	Installed Cost	Miles	Length (lf)	Total Cost
8-Inch	$250	0.38	2,018	$504,455
10-Inch	$300	0.00	15	$4,500
15 to 24-Inch	$500	1.15	6,090	$3,044,765
27 to 36-Inch	$550	1.45	7,698	$4,233,818
42 to 72-Inch	$600	3.18	16,770	$10,061,970
>72-Inch	$700	0	0	$0
Total		6.17	32,590	$17,849,508

Number of Manholes	Installed Cost	Total Cost
96	$5,000	$480,000

Based on straight-line depreciation over a 75-year service life, it is estimated that **the Authority should be reinvesting approximately $300,000 annually toward sanitary sewer and manhole rehabilitation and/or replacement.** Investment in measures such as lining to extend the lifespan of existing infrastructure is likely to decrease capital cost of interceptor replacement. A large portion of the replacement cost is due to the large diameter sewers that are currently in service, the 42-inch to 72-inch sewers account for a little over half of the anticipated costs.

Table 3-5: Interceptor Sewer Annual Reinvestment Estimate

Sanitary Sewer Pipe Cost	$17,849,508
Manhole Cost	$480,000
Total Collection System Cost	$18,329,508
Engineering & Contingency (25%)	$4,582,377
Total Cost	$22,911,884
Design Life (Years)	75
Annual Reinvestment:	$305,492

3.2 EXISTING CONVEYANCE CAPACITY

A properly designed collection system is capable of conveying peak wastewater flows without surcharging of the sewers. Basement backups and surface overflows can occur if surcharging becomes too great. Surcharged conditions result when gravity sewer capacity is inadequate to convey the peak flow. Surcharging also occurs when flow is backed up in the sewers upstream of lift stations that lack sufficient pumping capacity and cannot keep up with the peak flow. This can also be attributed to blockages and insufficient sizing.

This section includes an evaluation of the capacity of the main trunk interceptor sewers upstream of the Authority's WWTP and of the pumping capacity at each lift station maintained by the Authority. The adequacy of the existing force mains to convey the pumped flow at each lift station is also discussed.

3.2.1 Sewer Capacity

Gravity sewer capacity is a function of pipe diameter and slope. Both must be known in order to calculate sewer capacity and evaluate system conveyance capacity.

The Authority is continually refining the GIS Database for the collection system, and have the majority of the pipes inventoried with comprehensive data such as sewer slope, diameters, inverts, etc. However, not everything is populated, and work is still being performed to both add and correct existing and missing data. It is recommended that the Authority, as part of its CMOM program, continue to collect and record the necessary data to properly assess the collection system hydraulics and prioritize current and future areas of concern. Two of the Authority's major interceptor sewers (North and South Interceptors) have been recently studied, both for capacity, as well as inventoried/CCTV'ed. The information gained from these studies should be incorporated into the existing GIS system.

As identified in the 2017 Inflow/Infiltration Study, the sewer capacity of the interceptors is stressed in several areas, largely due to infiltration and inflow. The levels of I/I in these areas are easily determined to be excessive. Efforts should be undertaken to locate and remove these sources of clear water. The Glenbard 2017 Flow Monitoring Report performed by RJN Group identified multiple basins that should be further investigated, and potentially identified for rehabilitation. These efforts may need to be performed in conjunction with the tributary communities in order to mitigate I/I upstream of the interceptor sewer, and to further resolve the issue.

It is recommended that a Sanitary Sewer Evaluation Study (SSES) be completed to further investigate and inspect the existing collection system, locate sources of I/I, and develop a long-term Collection System Rehabilitation Plan. An SSES was also recommended as part of Authority's existing CMOM Program, as well as 2017 Flow Monitoring Report.

3.2.2 Force Main Capacity

Force mains convey flow that is pumped from lift stations and are typically designed for a minimum scouring velocity of 2.0 fps and a maximum velocity of 6.0 to 8.0 fps. Conditions in the Authority's existing force mains are summarized in Table 3-6.

Table 3-6: Force Main Desktop Analysis

Lift Station	Force Main Diameter (inches)	Rated Pumping Capacity (gpm)	Velocity at Pumping Capacity (fps)
Hill Avenue	16	2,500	3.99
South Regional Interceptor	10	2,850	11.64
St. Charles Road	18	7,360	9.28
Sunnyside	4	300	7.66
Valley View	10	1,540	6.29

The existing force mains are adequately sized for the installed pumping equipment, however a few of the lift stations exceed the recommended maximum velocities. Velocities in the South Regional Interceptor and St. Charles Road force mains are on the high side and will limit any future increase in pumping capacity. However, the SRI force main is fairly short in length and the additional friction losses incurred due to higher velocities are minimal.

3.3 Interceptor Sewer Rehabilitation

3.3.1 North Regional Interceptor

The North Regional Interceptor (NRI) carries flow from both Glen Ellyn and Lombard to the Treatment Plant. The interceptor sewer system was placed into operation in 1982 and is considered one of the core elements of the GWA's conveyance system along with the CSO Facility, which is located along the NRI alignment. The NRI measures approximately 23,000 feet in length and varies between 33" to 66" in diameter. It is constructed of pre-stressed concrete cylinder pipe (PCCP) and runs roughly from St. Charles Road and I-355 to the Treatment Plant. Throughout the route, the NRI receives discharge from the surrounding communities.

In 2001, a comprehensive inflow and infiltration (I/I) study was performed and helped identify several problem areas that were contributing to the I/I issues. As a result of this study, the Authority completed rehabilitation efforts to reduce I/I and as part of that effort both Lombard and Glen Ellyn now operate on-going I/I reduction programs. The level of infiltration discussed in Section 2 of this report indicates that the I/I programs should be analyzed, as the amount of inflow to the treatment facility was excessive. Although a lot of work has been already completed by the different communities, further measures should be taken to address this ongoing problem. In an effort to continue to combat this issue, the Authority recently performed a televised study of the interceptor system, and those findings should be used for future improvements.

Metering vaults along the NRI use area-velocity meters and data recorders to calculate flow through the interceptor associated with each contributing Village. These meters have recently been transitioned for maintenance and upkeep by a third party and should continue to be replaced or upgraded, as more accurate technology has become available since their installation. As part of this transition, a I/I evaluation was performed, and a review of that study is included within this section.

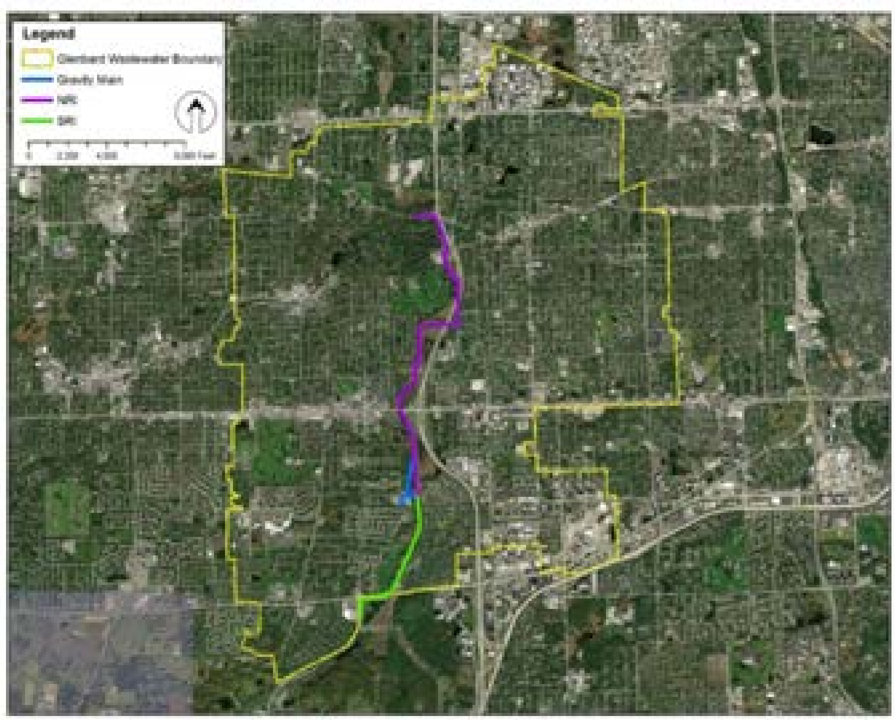
The NRI contains three flow regulating structures that divert high flows (flows above 2.5 times the average dry weather flow) from the interceptor to the CSO Facility. These structures use vortex regulators for flow diversion and have no moving parts. These devices require minimal maintenance but should be scheduled for routine cleaning.

3.3.2 South Regional Interceptor

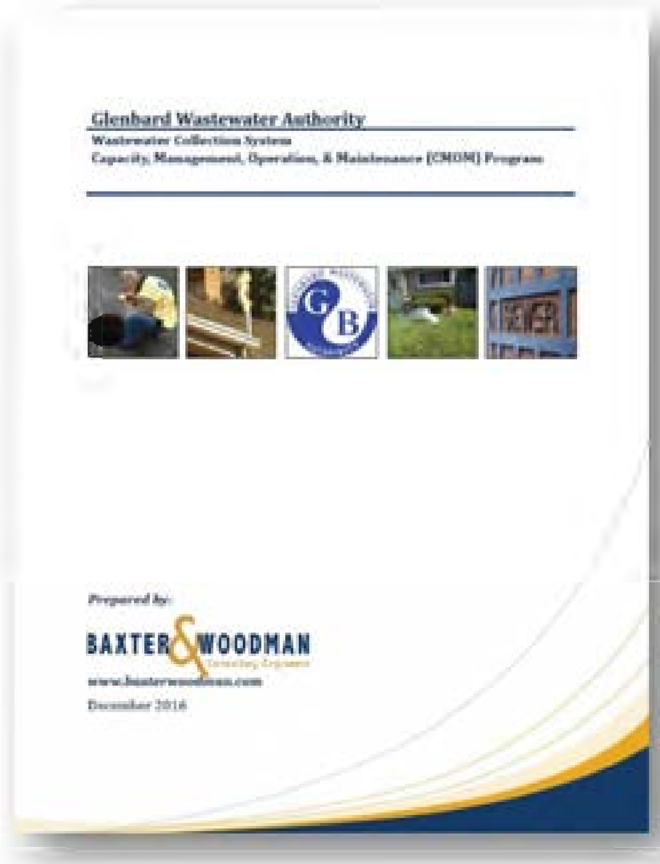
The South Regional Interceptor (SRI) also was placed in operation in 1982. It conveys flow from Glen Ellyn and a residential area in unincorporated DuPage County that is served by Illinois American Water, a division of American Water. The SRI begins as a force main from the Valley View Lift Station and becomes a gravity trunk sewer. It runs approximately 9,000 linear feet from the intersection of Route 56 and Route 53 to the Glenbard WWTP and has a diameter of 36” PCCP. Approximately 1,200 linear feet of PCCP was lined in 2002, the specific section that was lined included a portion under the East Branch of the DuPage River near the southern terminus of the SRI.

Similar maintenances and upgrade actions should be taken for the SRI as the NRI. Further studies should be dedicated to reducing I/I to the SRI, as well as incorporating the findings from the televising of the interceptor system into future improvements. I/I reduction and monitoring are especially crucial for the SRI as it travels adjacent to or underneath the East Branch of the DuPage River for much of its length, increasing the likelihood of infiltration from the surrounding soil, and damaged/aged pipe.

Exhibit 3-2 NRI/SRI Map



3.5 CAPACITY, MANAGEMENT, OPERATION & MAINTENANCE (CMOM) PROGRAM



Proper planning and maintenance of the collection system is an integral component of the proper management of wastewater systems as a whole. It helps to prevent operational issues from impacting existing customers and allows the Authority to plan service to future customers.

A Capacity, Management, Operations and Maintenance (CMOM) Program is a comprehensive program outlining a municipalities plan for managing, providing/maintaining capacity, operations and maintenance of its collection system and lift stations. EPA describes a CMOM as an “approach that outlines a dynamic system management framework that encourages evaluating and prioritizing efforts to identify and correct performance-limiting situations in the collection system”. It defines measurable goals for system operation and maintenance, outlines the specific tasks (including frequencies) needed to achieve the goals, quantifies the resources required, and identifies the positions within the organizational structure responsible for implementing various aspects of the CMOM. CMOM programs allow communities to document a proactive approach to maintaining their systems, as well as provide a goals and checkpoints to all tributary communities, such as the Village of Glen Ellyn and Village of Lombard.

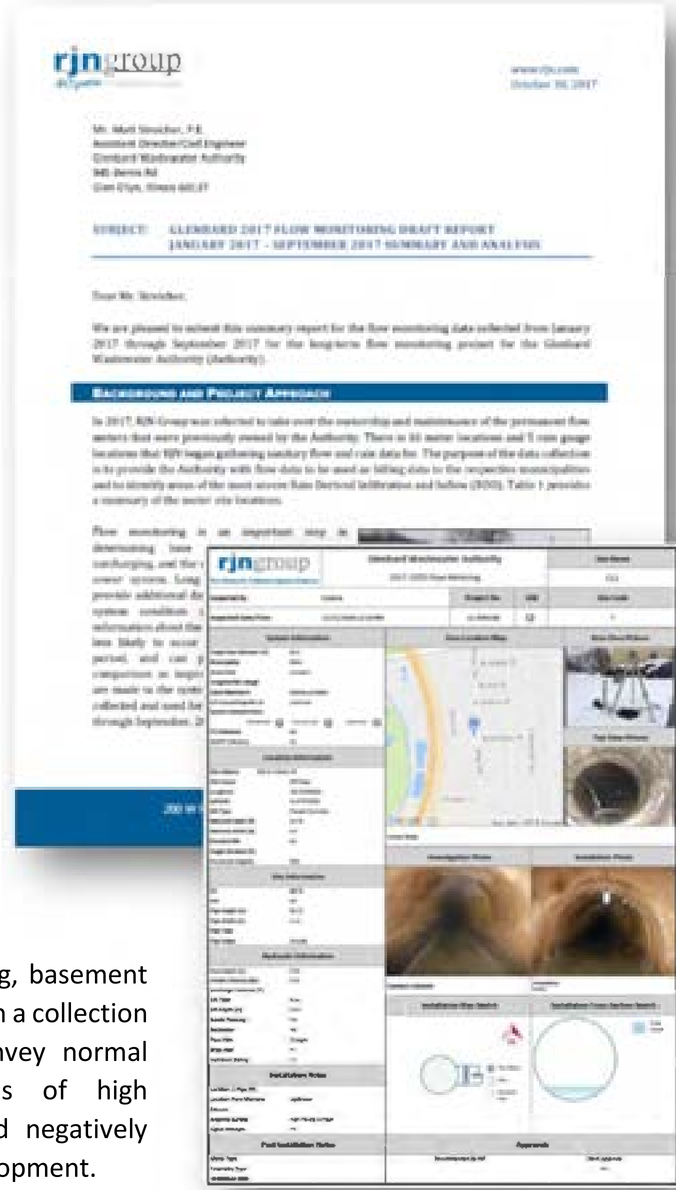
The Authority completed the development of their CMOM program in December of 2016. The CMOM program outlines the Authority’s service area, collection system, lift stations, management programs, operations and maintenance programs, and performance & goal review. To find more information about the collection system and the programs that the Authority has implemented, refer to the December 2016 CMOM Program.

As part of that report it was recommended that two special studies be completed, an Infiltration/Inflow analysis and a Sewer System Evaluation Survey (SSES). It is recommended that the CMOM program be reviewed every one to two years to determine whether the goals are being achieved, and to identify any changes that need to be incorporated. It is also recommended that all tributary communities be incorporated in the development and maintenance of the existing CMOM program, and their contributions be reviewed annually. This would include the existing I/I control program and efforts that have been made each year documented and evaluated. This method could help develop a plan for the removal of all combined sewers as well as enforce the repair of critical infrastructure.

3.6 INFILTRATION AND INFLOW

3.6.1 General

The sewers within the collection system are of varying age and condition. As with many older collection systems, infiltration and inflow is a major concern. Infiltration consists of groundwater that enters into the collection system through pipe joints, manhole joints, and structural defects (e.g. cracked pipes, sewers, brick manholes). Inflow is storm water runoff that discharges directly into the collection system through leaking manhole covers or directly connected downspouts, sump pumps, footing drains, and cross-connections.



Infiltration and inflow (I/I) increases the flow which must be conveyed by the collection system and can cause major operational issues. Flows can vary significantly during long dry weather low flows, as well as during the spring months and when soils are saturated. A reasonable amount of I/I is to be expected in any underground collection system, however excessive amounts of I/I can lead to surcharging, basement backups, and overflows. The presence of I/I within a collection system reduces the capacity available to convey normal domestic wastewater flows during periods of high groundwater and/or wet weather events, and negatively impacts the ability to accommodate future development.

As part of the Authority's efforts to complete tasks as outlined within their CMOM program, as well as to be proactive in rehabilitation efforts, an Infiltration and Inflow study was completed in October of 2017 by RJN Group, Inc. The study consisted of reviewing data (collected from January through September 2016) from 16 flow meters, and five rain gauges throughout the collection system. The study was performed in a manner as to help the Authority identify base flows, causes of surcharging, sources of I/I, etc. During the study period, the flows that were observed had good periods of dry-weather flows to help establish a good baseflow value for the sewers observed. In addition, the period of monitoring also included several wet weather events, and even a large 50-year, 24-hour event.

The findings of the flow meter study outlined that several of the basins had a "high level of concern" based on the data that was obtained and are identified in Table 3-7. Some of the areas that were outlined with a high level of concern included areas of the collection system that are still considered combined sewers. Typical rehabilitation techniques such as pipe replacement, joint grouting, CIP lining, etc. would not remove the I/I that is entering the system. Therefore, in order to correct this issue, it requires the sewers to be separated and no "quick fix" may be available.

However, other metered locations were also identified as high levels of concern that are not considered combined sewers. These locations were Wilson Ave (Lombard), NW Glen Ellyn (Glen Ellyn) and N-36 (Glen Ellyn). These particular locations could potentially be candidates for rehabilitation techniques such as pipe replacement, joint grouting, CIP lining, etc. Overall, the report identified that most of the locations that the meters were setup exhibited severe downstream surcharging and control for smaller events such as a 1-year, as well as 6-month reoccurrence. Therefore, there may be obstructions downstream impeding flows from conveying to the treatment facility. The Authority should review the recent CCTV program footage and identify if more routine cleaning or root cutting/mitigation may be required. If that is the case, the Authority could implement a root cutting program, or root control program. Overall the I/I report identified that it appears that the Authorities system (interceptors) are being overwhelmed with infiltration and inflow, however the inflow is the larger concern and value.

Table 3-7: 2017 I/I Study Results

Meter	Base Infiltration	RDII	DS Control	Level of Concern
Glen Ellyn Meters				
Glen Ellyn Heights	High	Low	MILD	Low
NW Glen Ellyn	Low	High	MODERATE	High
N-36	High	High	SEVERE	High
N-15	High	Low	SEVERE	Moderate
NRI Maryknoll	Low	Low	SEVERE	Low
West Glen Ellyn	Moderate	Moderate	SEVERE	Moderate
Lombard Meters				
Hill Ave	Low	Moderate	SEVERE	Moderate
North Lombard*	High	High	SEVERE	High
Central Lombard*	Moderate	High	SEVERE	High
Wilson Ave	Moderate	High	SEVERE	High
L-22B	Low	Moderate	SEVERE	Moderate
L-22A	High	Low	SEVERE	Low
Valley View Meters				
SRI	Moderate	Low	MODERATE	Low
Combined Meters				
Lombard NRI	High	Moderate	SEVERE	**
NRI	High	Moderate	SEVERE	**
GWA Effluent	High	Moderate	MILD	**

* North Lombard and Central Lombard have partially combined sewer system tributary areas
** Basin's LOC is not assessed as they are combinations of other basins
***Data from October 2017 I/I Study performed by RJN Group

3.7 Sanitary Sewer Evaluation Study (SSES)

A Sanitary Sewer Evaluation Survey (SSES) is a series of field investigation techniques used to identify specific sources of I/I. A variety of methods are typically used including manhole inspections, closed-circuit televised (CCTV) inspections, smoke testing, dyed-water testing, and sump pump inspections. Each of the inspection techniques mentioned above are discussed in further detail below, each has its most effective application. An effective SSES could include all or some of these methods depending on the unique character of each system.

A comprehensive investigation can identify I/I sources within the public sector (such as leaking manholes, leaking pipes, and cross-connections between sanitary and storm sewers) as well as within the private sector (leaking service laterals and illegally connected downspouts, sump pumps, foundation drains and area drains). Areas within the collection system that experience chronic I/I have been identified. It is recommended that the Authority implement the SSES program as prioritized above. In subsequent years, the remaining areas can be inspected. An annual SSES program would ultimately and systematically address the entire collection system.

The recommended SSES would complete a portion of the Authority's CMOM Program, fulfill previous facility planning recommendations, and would ultimately be incorporated and made part of the updated CMOM document. One product of the SSES would be a long-term Collection System Rehabilitation Program. This program could be developed in conjunction with the neighboring communities that are currently maintaining their own collection systems. In addition, this could incorporate public outreach to address other long-term problems such as the use of sanitary wipes and them entering the collection system.

3.7.1 Manhole Surveys

Typically, as part of an SSES program, recommendations to complete a manhole survey are made. At this time the Authority has already started performing manhole surveys and collecting infrastructure data. In addition to collecting the data, the Authority has also been developing a more thorough GIS database and populating fields as the data becomes available. The goal is for the Authority to have a more robust and complete GIS database that can be used for future planning. Currently the Authority has already collected information such as the following:

- Manhole rim elevations & ID
- Manhole construction
- Sewer pipe diameters and material of construction
- Sewer invert elevations at manholes
- Sewer segment lengths

As the database continues to get refined and updated, it is recommended that the Authority also collect the following data.

- Manhole cover data (size, pick hole type, stamping, etc.)
- Pictures of manhole interiors
- Manhole condition

The manhole survey and compilation of the data help satisfy a portion of the mapping element that is required for the Authority's CMOM Program. Additionally, it will also provide the data necessary to populate an important component of the GIS data base.

As manhole survey/data collection is done it should include investigations of cracks and joints, sewer connections, cone and adjusting ring sections, and the general structural integrity inside the manhole. The interior of each manhole should be inspected to identify defects and detect signs of infiltration. The Authority already performs an annual walking inspection in which the staff walks the length of the interceptors to look for blown manhole covers or other evidence of system overflows. As part of this work, Authority staff could also perform manhole data collection.

A large quantity of inflow can enter through open pick holes in manhole covers, between the cover and casting where seals are deteriorated, or under the casting and/or adjustment rings. Inspection would identify manholes located near creeks, rivers, or lakes and ponds susceptible to flooding in high water conditions. Manholes located in or near open drainage ways would also be identified as would manholes in areas where street or area flooding could occur, or surface runoff could drain over the manhole cover. Manhole surveys and interior inspections are most effective when done during wet weather conditions, although signs of I/I may remain evident even during dry weather conditions.

3.7.2 Closed Circuit Television (CCTV) Inspection - Y.E.S. (YOUR ENTIRE SYSTEM) PROGRAM

CCTV inspection of the interior of sanitary sewers is the only definitive means of observing the interior condition of the sewer pipes and provides clear evidence from which to prioritize sewer rehabilitation and repairs. CCTV inspection can identify structural defects, maintenance issues affecting conveyance capacity (specifically, build-up of grease, sediment, and tree roots), and sources of I/I (particularly when done in conjunction with dyed-water testing). Both the structural and maintenance conditions of a sewer can change significantly over time and sewers should be televised at least once every 10 years. The Authority recently enrolled in and completed the RedZone Robotics "Y.E.S." program (Your Entire System Program). With this program, RedZone televises and rates all of the sanitary sewer manholes and collection system in accordance with NASSCO requirements.

All of the data that is collected is combined into one database outlining all of the Authority's assets, exact location, and current condition. The data can be viewed in RedZone's ICOM3 wastewater asset management software. All of the data can be viewed to identify problem areas within the collection system based on items such as deposit blockages, tree root intrusion, sources of I/I, structural deficiencies, etc.

Ultimately, the Authority will be able to use this data to evaluate the collection system as a whole and develop specific projects to tackle their needs. Authority staff will be able to make educated decisions on cleaning locations, and repair/replacement programs. In addition, the Authority will be able to work in conjunction with each of the communities within the FPA to develop a replacement program that coincides with their street programs. This could allow the Authority and the communities within the FPA to have a cost sharing of the overall project.

3.7.3 Smoke Testing

Smoke testing is a tool utilized to locate sources of infiltration and inflow. Smoke testing entails blowing a manufactured smoke into isolated sections of the sanitary sewer system. The smoke has the reverse effect that groundwater has on the sewer system. The smoke leaks out of the sewer and manholes through cracks and joints and appears at the ground surface.

Smoke testing is also a valuable tool in locating cross connections with storm sewers, roof downspouts, and foundation drains. Sump pumps connected to the sanitary sewer system can sometimes be identified where check valves are not installed on the pump discharge pipe. Smoke testing is best performed in dry weather conditions so that ground water will not impede the travel of smoke out of the sewer or manhole and through the ground.

Smoke testing sometimes uncovers improperly sealed and/or vented plumbing systems. Even though smoke testing is performed to find sources of I/I, the identification and correction of these plumbing issues is a positive public benefit.

3.7.4 Rainfall Simulation/Cross-Flooding

Otherwise known as cross-flooding or dye-testing, rainfall simulation is usually performed in selected areas as a follow-up to smoke testing. It assists in identifying infiltration locations noted during smoke testing and helps quantify the amount of infiltration entering the sewer system. Colored water is introduced to drainage ways, swales, storm sewers, culverts, and area drains, and the sanitary sewer system flows are then observed for indications of the dye in the system.

When rainfall simulation is performed in conjunction with televising, the locations of leaks can actually be observed, otherwise the dye can only be observed at manholes. Rainfall simulation should be scheduled following smoke testing, preferably in coordination with sewer televising. The rainfall simulations can be performed in either wet or dry weather conditions.

3.7.5 Sump Pump and Drain Disconnection Program

It is recommended that the Authority work with their users to implement a program to inspect for and disconnect sump pumps as well as a footing tile and downspouts. This will help to eliminate illicit discharges from these direct connections and reduce the amount of clear water tributary to the system.

These types of illegal connections to the sanitary sewers are typically prohibited by Village/City/ Municipal Ordinance. Residents who are not in compliance should be given adequate time to remove these connections. At minimum, inspections should be conducted and disconnection completed at time of any property transfer, or when building permits are issued. House to house inspections could be completed in conjunction with the recommended CCTV inspections and/or smoke testing efforts, however these visits may be better performed by community (Glen Ellyn/Lombard) staff due to the sensitive nature of these inspections.

To complement the proposed ordinance, the Authority might also consider a private sewer lateral cost sharing program. The program would provide grants from the Authority to property owners for 50 percent of the cost of a full sewer lateral replacement (from where it exits the structure to the main line connection) where laterals are found to be leaking. Providing grant money for property owners to aide in the rehabilitation of private sewer laterals in need of repair will assist in reducing I/I within the collection system to the benefit of all users.

3.7.6 Grease Trap Inspections

The Authority should perform or have tributary communities perform grease trap inspections and enforce code compliance. Routine inspections are conducted; however, grease inspections typically only occur in response to an odor complaint or a sewage backup. Both tributary Villages have recently adopted FOG ordinances with the aim of grease reduction for food service and processing establishments, and the Authority's Environmental Resources Coordinator carries out routine inspections of grease traps. Additionally, the Authority requires pump out manifests from contributors of FOG. The purpose of the ordinances are to assist in the prevention of sanitary sewer blockages, obstructions and SSOs caused by the accumulation of fats, oils and grease in the sewer system.

3.7.7 Sewer Cleaning

Sewer cleaning involves jetting to remove accumulated sediment and grease and cutting of intruding roots. The extent of these conditions depends strongly on the area tributary to the sewer, the cooking habits of residents and businesses in the area, and sewer pipe material of construction. For example, sewers in parkways and back-yard easements are more likely to experience root intrusion. Similarly, sewers in areas with restaurants are more likely to experience grease accumulation. Sewers with lower than minimum slopes or which have sagging low points are more likely to accumulate sediment. Sewers should be cleaned on average every three years, with increased frequency for those sewers that tend to accumulate roots, sediment, or grease.

The Authority currently has an aggressive sewer cleaning program that consists of televising its interceptors once every five (5) years at a minimum. This inspection should continue to be performed as years progress, and as more information becomes available, any problem areas should be address immediately.

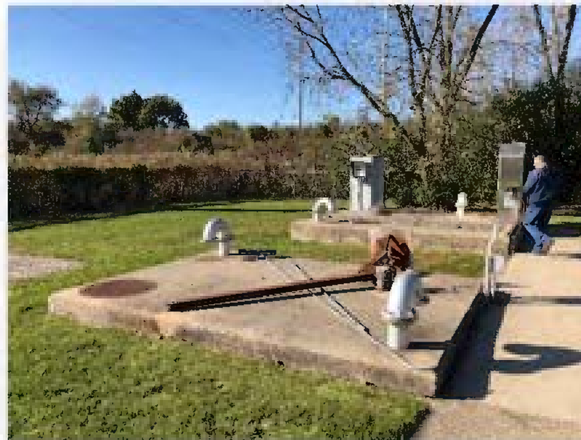
3.7.8 Flow Monitoring Program

A flow monitoring program is another tool that can be used to obtain accurate data on wet weather flows throughout the collection system, providing additional information in accessing the need for rehabilitation. The Authority has recognized the need for this work and has already purchased 16 flow-meters that monitor flow in its two interceptors.

Authority staff does not perform the operation and maintenance of these flowmeters, and it is completed by a third-party contractor. It is recommended that the Authority continue this program and continue to refine it to identify the problem areas. However, flow monitoring can be costly, and it is recommended that the manhole inspections be completed and sanitary sewers be televised in the priority areas to expedite the process of reduce I/I and resolve problem areas.

3.8 LIFT STATIONS

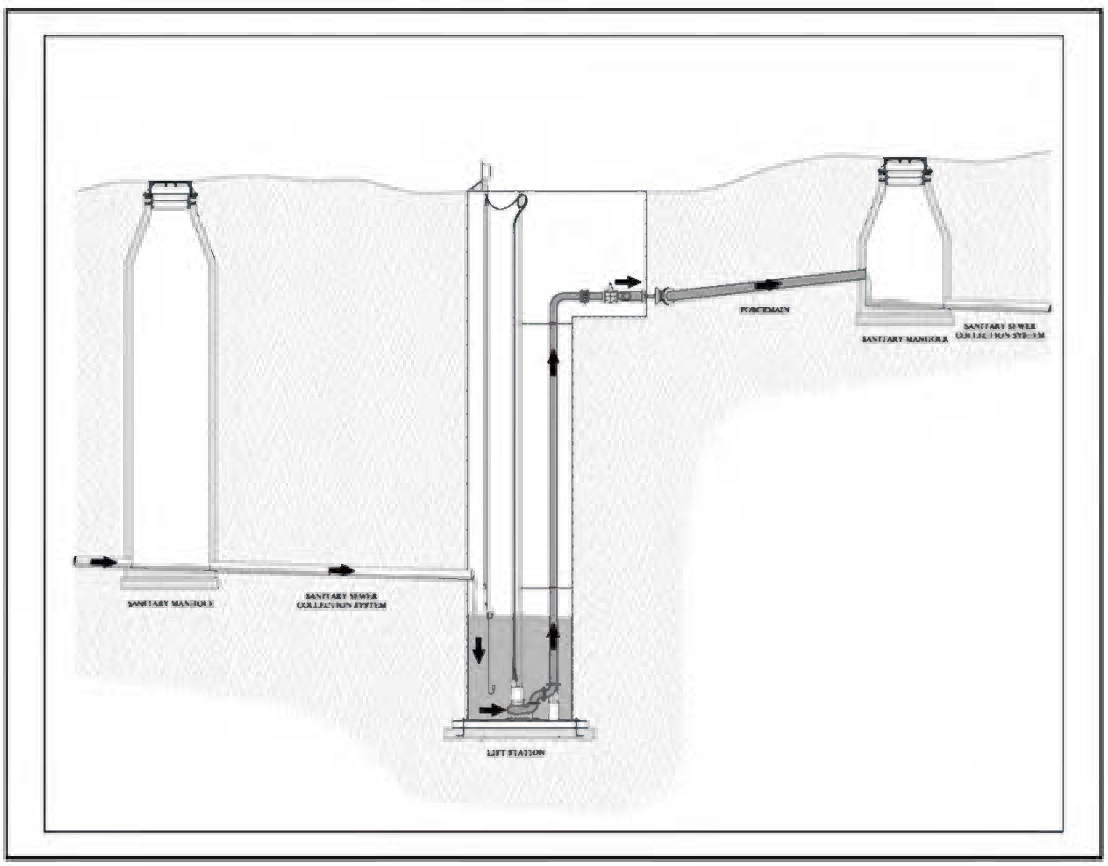
This section describes each of the existing Glenbard Wastewater Authority's lift stations, including their tributary service areas and force mains. Each lift station is assessed based on flows and the results of pump drawdown tests are presented.



3.8.1 General Information

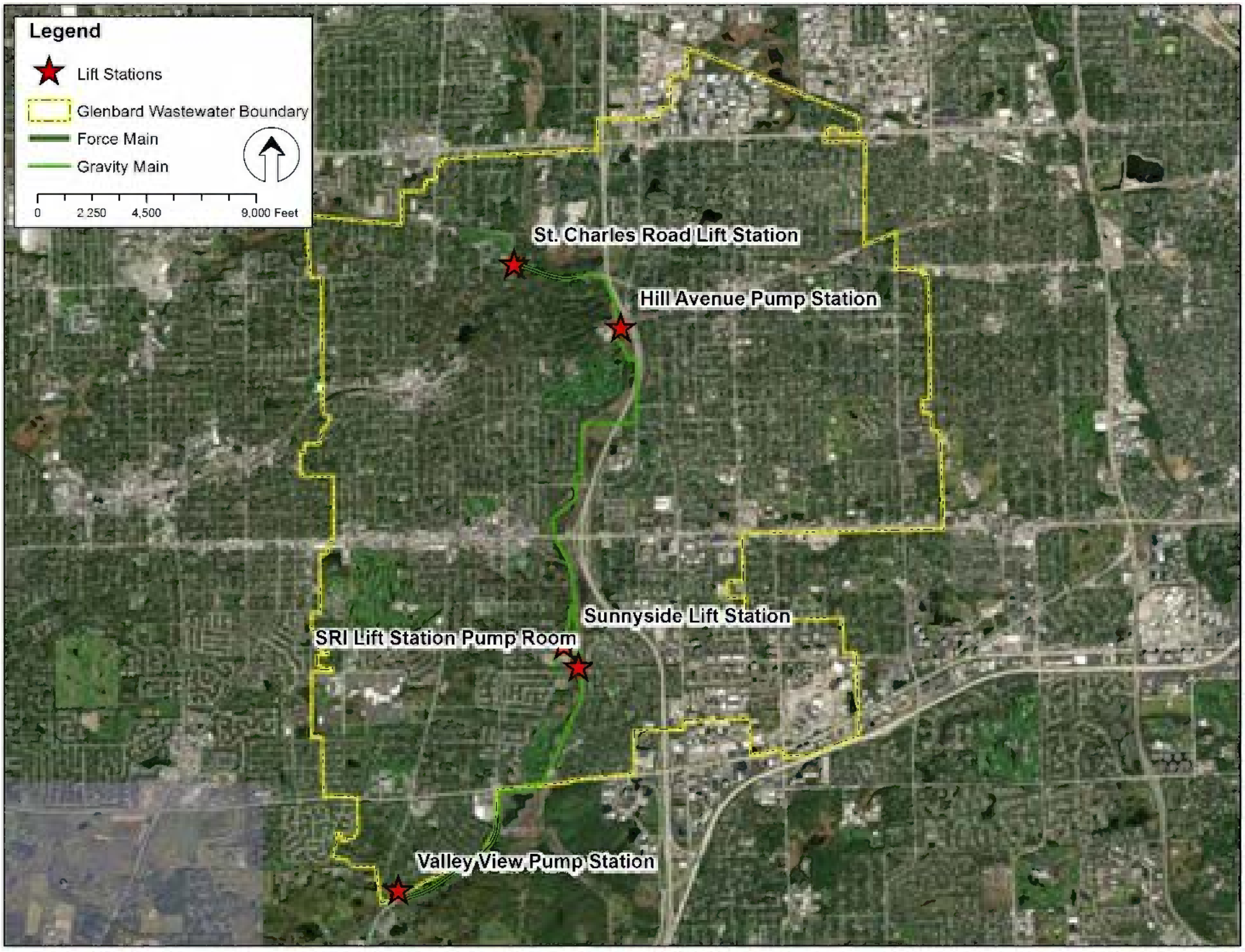
The Glenbard Wastewater Authority collection system maintains four lift stations. Sanitary sewers utilize gravity to convey wastewater. Depending on soil conditions and other factors, such as ground water and ground surface topography, gravity sewers are not always feasible or cost-effective. Lift stations are constructed to pump the wastewater through force mains to higher elevations. The wastewater is then discharged to the downstream gravity sewer. The arrangement of a typical lift station is shown in Exhibit 3-4.

Exhibit 3-3: Typical Lift Station



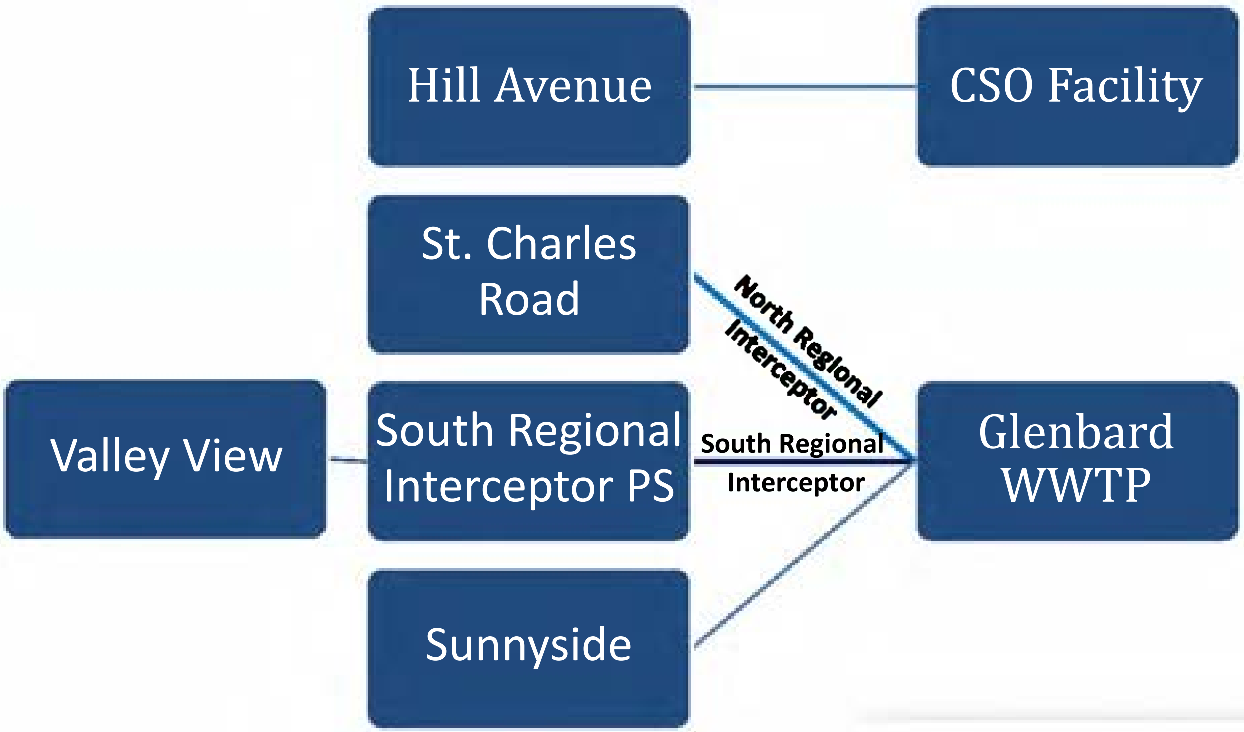
The locations of each of the Authority's lift stations are shown in Exhibit 3-5.

Exhibit 3-4 : Glenbard Wastewater Authority Lift Station Locations



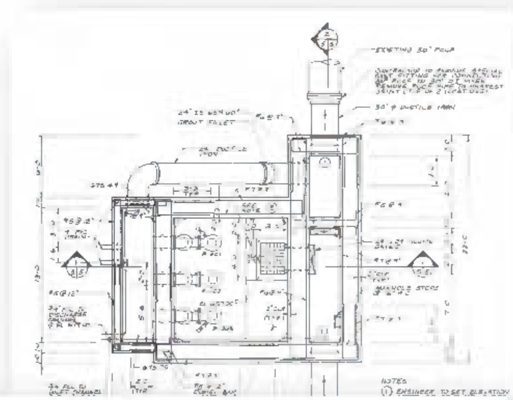
A schematic of the interconnection of and flow from each lift station through Glenbard Wastewater Authority's collection system is shown in Exhibit 3-6.

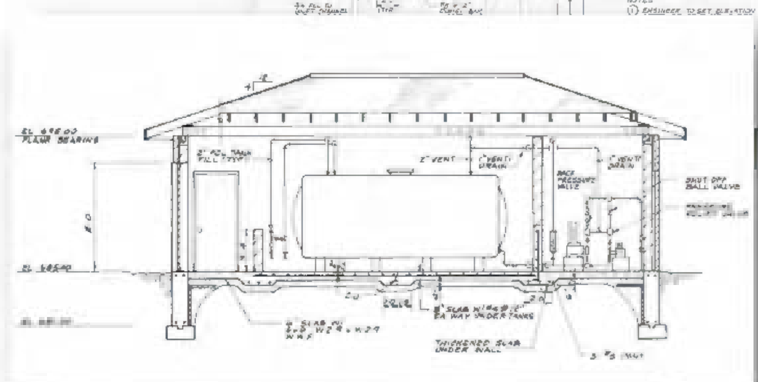
Exhibit 3-5: Lift Station Flow Diagram



3.8.2 SRI Lift Station

The SRI Lift Station is located at the Glenbard WWTF, at the northern limit of the SRI. This pump station was constructed in 1993 to prevent high wet weather flows from the NRI surcharging the SRI. The Valley View Lift Station is tributary to the SRI pump station, and therefore all future developments within the tributary areas of the VVLS need to be verified with the capacity of the SRI pump station. The submersible pumps were replaced in 2008 and are not anticipated to require major renovations in the next several years. The estimated useful service lift of these pumps is approximately 20 years with routine maintnenace, and as such the condition should be reviewed in subesequent Facility Plans.



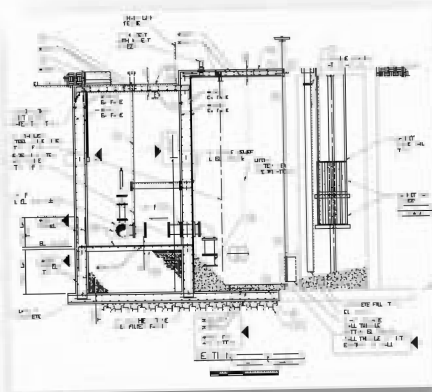


3.8.3 Valley View Lift Station

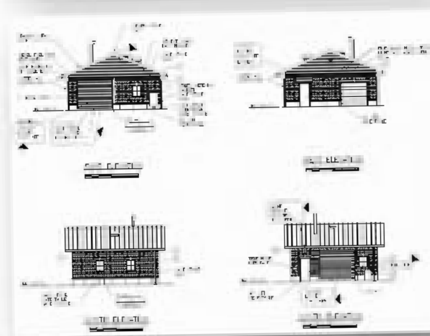
The VVLS serves a small residential area in southern Glen Ellyn, at the intersection of Route 53 and Route 56. The facility was originally installed in the late 1970s and discharges through 5,600 linear feet of 10" PVC force main to the head of the South Regional Interceptor. The pump station originally consisted of a steel wet well and dry pit valve vault/pump station with an emergency generator.

The facility was upgraded in 2015 with a submersible pump station within a precast concrete structure. Several site modifications were made, including the addition of a new pump station control building with electrical, generator, and service rooms. Facility upgrades included installation of two 85 horsepower submersible pumps, a valve vault, emergency bypass connections, and magnetic flow metering. This station is not anticipated to require significant rehabilitation in the 10-year planning horizon.

3.8.4 St. Charles Road Lift Station



The St. Charles Road Lift Station pumps flow from northwest Glen Ellyn to the head of the North Regional Interceptor to be conveyed to the WWTF. The lift station connects to the NRI through a 2,700-linear foot, 18-inch diameter PCCP force main. The adjacent structure houses a standby generator, fuel tank, and all necessary electrical/SCADA equipment.



The lift station underwent major or renovations in 2010, which upgraded the pump station from 7.5 MGD to a 10.6 MGD. The rehabilitation included expanding the existing concrete wet well and constructing a new generator/electrical building. In addition, VFD's were added to improve the overall efficiency of the system due to the large range of flows that this facility can receive. The pump station is in good condition and there is no expectation of any major rehabilitations/improvements within the next 10 years. Routine maintenance should be continued at this facility to keep it in good operating condition.

3.8.5 Sunny Side Lift Station

The Sunny Side Lift Station is located at the Glenbard WWTF and serves the adjacent Sunnybrook neighborhood. It was constructed in response to realigning of the NRI in the late 1970's. It prevents sewer surcharges due to high water levels in the WWTF influent chamber. The Sunny Side station is the smallest of the Authority's lift stations. The pumps at the Sunny Side Lift Station were replaced in 2015, along with the base elbows. It is recommended to revisit expansion of this facility in the next Facility Planning period as there is a potential for subdividing parcels to the north of the facility in the near future.

Sunny Side Lift Station Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$50,963
SITE WORK	$63,212
LIFT STATION REPLACEMENT	$88,650
ELECTRICAL & CONTROLS	$52,000
Construction Sub-Total	$254,825
Contingency @ 15%	$38,224
Engineering @ 15%	$43,957
PROBABLE PROJECT COST:	**$337,007**

3.8.6 Hill Avenue Lift Station

The Hill Avenue lift station is located at the site of the existing CSO facility. This pump station will be reviewed in Section 4 as part of the CSO Facility.

3.8.7 Lift Station Asset Value & Replacement Costs

The estimated asset value (based on probable replacement cost in 2018 dollars) of each existing of Authority's lift station is listed in Table 3-8

Table 3-8: Asset Value of Lift Stations

Lift Station	Estimated Replacement Cost	Equipment/Pumps & Controls		Structures, Piping & Valves	
		Estimated Value (1)	Annual Depreciation (2)	Estimated Value (1)	Annual Depreciation (2)
Hill Avenue	$1,000,000	$400,000	$20,000	$600,000	$15,000
SRI	$750,000	$300,000	$15,000	$450,000	$11,250
St. Charles Rd	$2,507,000	$1,002,800	$50,140	$1,504,200	$37,605
Sunny Side	$300,000	$120,000	$6,000	$180,000	$4,500
Valley View	$2,065,000	$826,000	$41,300	$1,239,000	$30,975
Total	**$6,622,000**	**$2,648,800**	**$132,440**	**$3,973,200**	**$99,330**
(1) Equipment estimated at 40% total value. Structures and piping estimated at 60% total value.					
(2) Equipment assumed to have 20-year life. Structures and piping assumed have 40-year life.					

Sufficient replacement funds should be established to support the rehabilitation and repair efforts necessary to ensure the continued future reliability of the aging lift stations. Based on the depreciation rates listed in Table 3-8, the Authority should be reinvesting approximately $231,770 annually toward lift station rehabilitation and/or replacement.

3.8.8 Lift Station Pump and Force Main Data

The Glenbard Wastewater Authority maintains five (5) lift stations in operation throughout the FPA, conveying flow from the collection system to the Wastewater Treatment Facility. Each of the lift stations has several key components including the pumps and force mains. Some of the features have been identified in Table 3-9.

Table 3-9: Lift Station Pump and Force Main Data

Lift Station	Pump Manufacturer	Pump Motors (HP)	Pump 1 Rated Capacity (gpm)	Pump 2 Rated Capacity (gpm)	Pump 3 Rated Capacity (gpm)	Pump 4 Rated Capacity (gpm)	Pump 5 Rated Capacity (gpm)	Force Main Diameter (in)	TDH (ft)
Hill Avenue	ABS	27	2,500	2,500	N/A	N/A	N/A	10	25
SRI	Xylem-Flygt	15	947	947	947	N/A	N/A	8	28
St. Charles Rd	Xylem-Flygt	Wet - 215, Dry - 34	Wet Weather - 5,800	Wet Weather - 5,800	Wet Weather - 5,800	Dry Weather - 1,580	Dry Weather - 1,580	18	Wet - 85, Dry - 56
Sunny Side	Xylem-Flygt	2.2	±150	±150	N/A	N/A	N/A	4	15
Valley View	Xylem-Flygt	85	1,540	1,540	N/A	N/A	N/A	10	138

3.9 Pump Drawdown Tests

Due to the overall condition and operation of the existing pump stations draw down tests were not performed at each station.

However, as the lift stations age it is recommended that each location have a drawdown test performed to estimate each pump's current output in relation to their rated capacities. Pump drawdown tests consist of timing the wet well fill and draw cycles, and for the known wet well volume, computing the average flow into the wet well and the average pumping rate. Three trials should be conducted at each lift station, running each pump individually and then one last trial with all pumps running.

Overall, the Hydraulic Institute Standards allow for a deviation from rated pump capacity of plus or minus 8 percent for municipal water and wastewater service (Grade 2B). Significant deviations from the rated capacity could be a result of a worn pump impeller, varying motor speed due to utility power supply, partially obstructed pump discharge or force main piping, or an improperly designed installation.

Prior to performing the tests, it is also recommended to install pressure gauges on the suction and discharge headers for every location that doesn't currently have them installed. In the absence of pump discharge recordings (meters) it is not possible to state with certainty the nature of the over- or under-pumping. In order to narrow the field of potential problems, it is recommended that a draw down tests with pressure gauges be performed. The pressure gauge data would allow for additional analysis to occur, the data could provide information on where the pump is running on its curve.

3.10 Lift Station Run Times

As part of the draw down testing, historical records of the lift station pump runtimes should be reviewed as well. Pump run times would help identify if the pumps are sufficiently sized for current and future flows, as well as aid in the isolation of existing problems. Since pumps alternate automatically, pump run times at a given lift station should be similar; large differences in run time values may indicate operational issues.

Smaller lift stations are typically designed in general to meet a peak flow of about 4 times the average flow, one would expect such pumps to run on average about 25 percent of the time, or 6 hours per day. Larger pumps sized for a peak to average flow of 3:1 would likewise be expected to run 1/3 of the time or about 8 hours per day at the design loading. Although identifying that a lift station is running at or above six hours a day provides a starting point, it does not isolate the problem. Increased pump run times could also potentially indicate a worn pump impeller, varying motor speed due to utility power supply, partially obstructed pump discharge or force main piping, or an improperly designed installation.

3.11 EMERGENCY STANDBY POWER

Lift stations require standby power to operate and to provide continuous service during power outages. When power failures occur, it is important to have an alternate source of power, such as a dual utility power feed, an on-site generator, or the ability to plug in a portable generator.

Two of the lift stations that are maintained by the Authority are equipped with onsite diesel generators. These are the St. Charles Road and Valley View Lift Stations. It has been in the Authority's long-term plan to provide onsite power for each of its lift stations to ensure proper operation during emergency situations. The two generators at sites were recently installed during the last rehabilitations and are anticipated to have plenty of service life remaining, typically the anticipated service life for a generator is 20-30 year depending on maintenance and upkeep. Based on the maintenance records and protocol that has been implemented by the Authority, a 30-year expectancy is anticipated.

It is recommended that as lift stations are rehabilitated over the next few decades that the existing backup power supply sources be evaluated. During the design process, it could be determined if the existing backup power supply source is appropriate, or if a backup generator should be installed onsite. Additionally, the Authority may want to consider future ATS's to have the ability for a generator quick connection to be incorporated. This may allow the Authority another option for source power under an emergency situation.

The existing onsite generators supplying power to the SRI and Sunny Side lift stations are reaching the end of their anticipated service life expectancy. Rehabilitation and/or replacement may need to be considered. It is recommended that the Authority perform performance testing on the generators and get them inspected to identify the true end of service life date, and to allow for budgeting for replacement.

Table 3-10: Lift Station Emergency Power Sources

Lift Station	On-site Generator	Portable Plug
Hill Avenue	Redundant Feeds	-
SRI	Natural Gas(1)	-
St. Charles Rd	Diesel	-
Sunny Side	Natural Gas(1)	-
Valley View	Diesel	-

(1) Backup power provided at the main plant.

3.12 SCADA AND CONTROLS

The Glenbard Wastewater Authority's lift stations have been equipped with SCADA devices which notify the Authority's staff under alarm conditions. Currently, the Authority is utilizing cellular communications as a means for transmitting data from each of the remote sites back to the main plant. There are several advantages to cellular communication than other methods such as radio and leased land lines, one of which typically being a lower total capital cost (if replacing the entire system), reduced concerns due to weather and interference, and eliminating the need to access hardware on elevated towers which presents a safety concern. However, monthly data transmission fees apply to cellular networks, and issues on the service provider's end can remove some of the control from the Authority's hands. The Authority has not typically had any issues with the system, and therefore it is not recommended that a modification be made to the transmission type. The Authority should routinely check the system, and budget funds for the replacement of equipment as it ages.

3.13 LIFT STATION REHABILITATION

The Glenbard Wastewater Authority currently owns and operates five lift stations. They have been constructed within the last thirty years. Table 3-11 identifies the installation years for each of the lift stations. The existing lift stations are generally in good condition. It is recommended that the Authority reinvest approximately $231,770 per year in the rehabilitation and/or replacement of the lift stations based on pumping equipment and structure life expectancy. Due to the majority of the lift stations being in relatively new condition, the majority of this funding should be allocated to the Sunny Side lift station. The Sunny Side station was constructed in the early 1980s and is reaching the end of its service life. It is anticipated that the construction cost for replacement of the Sunny Side Lift Station would be approximately $250,000, and a budget number of $300,000 should be used for engineering and construction.

Table 3-11: Lift Station Installation Year

Lift Station	Install Year
Hill Avenue	2001
SRI	2004
St. Charles Rd	2010
Sunny Side	1982
Valley View	2015

3.14 Conclusions and Recommendations

3.14.1 Drawdown Testing

The Authority should conduct annual pump drawdown testing at each lift station to determine and monitor the performance of the pumps. Provisions to properly attach pressure gauges during the pump drawdown tests would allow pressures to be recorded during the drawdown tests which would provide more meaningful results. Pressure readings would allow the Authority to identify the exact point on the pump curve that the existing pumps are operating, helping identify potential problems.

3.14.2 Security Features

The existing lift stations should include features to secure them from entry by unauthorized personnel and to minimize the risk of vandalism. Currently, all lift stations are within fence-lines. The St. Charles, Valley View, and Hill Avenue lift stations all have intrusion detection incorporated via SCADA. Extending this functionality to the remaining lift stations, along with improved exterior lighting, motion sensors, and cameras will provide greater security at lift stations moving forward.

3.14.3 Rehabilitation/Replacement

As stated previously, the Authority owns and operates five lift stations, most of which have been recently reconstructed and are in great operational condition. The Sunny Side lift station was constructed in the 1980s and, although it is in good operational condition, the Authority should begin budgeting for rehabilitation and/or replacement of the pump station. It is recommended that the Authority reinvest approximately $231,770 per year in the rehabilitation and/or replacement of the lift stations based on pumping equipment and structure life expectancy. However, for the complete rehabilitation/replacement of the Sunny Side Lift station, it is anticipated that the construction cost would be approximate $250,000, and a budget number of $300,000 should be used for engineering and construction.

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SECTION 4
COMBINED SEWER OVERFLOW (CSO) FACILITY

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4. Combined Sewerage Overflow (CSO) Facility

4.1 General Background

The Combined Sewerage Overflow (CSO) facility is operated by the Authority and is located at 625 Hill Avenue in Lombard. This facility is unmanned and is operated only during wet weather events. The CSO facility was constructed in 1982 on the ground of the existing Lombard Combined Sewage Treatment Facility (LCSTF). The CSO plant has been modified over the years and was last rehabilitated in 2012. The peak design flow for the facility is 58.0 MGD.

4.2 CSO Treatment Process

Some of the areas tributary to the Glenbard Wastewater Authority WWTP contain combined sanitary sewers. As a result, during periods of significant rainfall the Authority can receive large increases in flows both in duration and peak intensity. The WWTP can handle a design maximum flow of up to 47.0 MGD. Vortex regulators in the collection system limit flow into portions of the North Regional Interceptor (NRI) to 2.5 times the dry weather flow, and excess flow is diverted to the CSO facility. A portion of the flows to the CSO facility are pumped from the collection system via the Hill Avenue Lift Station. The pump station has a peak design flow of 5.6 MGD.

Influent flows to the treatment facility via four separate feeder sewers. The main source of influent is conveyed to Junction Box (“B”) to the east of the bar screen structure via a single 90” influent pipe. The 90” pipe receives flows from the NRI once it has surcharged to an elevation of 685.60’ and overtops a weir to start diverting flows automatically (within Junction Box “D”). In addition, two separate 30” and 54” pipes are tributary to Junction Box B. Each of which is limited in flows to 3.83 MGD and 1.93 MGD respectively. The 30” pipe serves the north end of Lombard, while the 54” runs due east. Both the 30” and 54” pipes have diversion structures that regulate flows, during wet weather events flows are automatically diverted to the CSO facility. The fourth and final sewer, which is tributary to Junction Box B, is from the Hill Avenue Pumping station. This pump station only operates under high flow events and when the Northern Area Sewer Flow Regulator Structure surcharges. Excess flows from this structure are diverted to the Hill Avenue pump station, pumped, and ultimately discharges to the head of the CSO facility.

The CSO facility provides only liquid stream treatment and does not perform any solids processing. All solids collected are drained from the tanks and sent to the main treatment facility for processing. The flows diverted to the facility undergo the following treatment procedures before discharge: primary screening, grit separation and removal, primary clarification, sodium hypochlorite disinfection, and sodium thiosulfate de-chlorination. Discharges from this facility are typically tributary to Outfall 001, though the site does have a second outfall for the lagoon, Outfall 002. There is also a 90” bypass around the entire plant identified as Outfall 003.

If flows exceed the design maximum flow of 58 MGD, the CSO facility’s flow is diverted to two lagoons. The lagoons have a design capacity of 14.5 MGD. Under typical operation, excess flow lagoons are used as storage and drained back to the head of the facility when the facility has sufficient treatment capacity.

In extreme flow conditions, effluent from the lagoons will discharge after eclipsing the level of the outfall weir. The outfall for the lagoons is identified as Outfall 002.

The CSO facility does not always process the flows that are diverted to it. During periods of significant rainfall, flows may be diverted to the facility and held until the storm has passed. Once the flows to the main treatment facility have subsided, the stored flows at the CSO facility are diverted back to the main treatment facility. These excess flows can then undergo full treatment at the main plant before being discharged.

The Authority utilizes a Supervisory Control and Data Acquisition System (SCADA) to control and monitor the treatment processes at the CSO Facility. This setup allows the Authority to operate this facility unmanned during off hours and is also equipped with dual feed electrical sources from the utility.

Figure 4-1: CSO Facility Process Flow Diagram

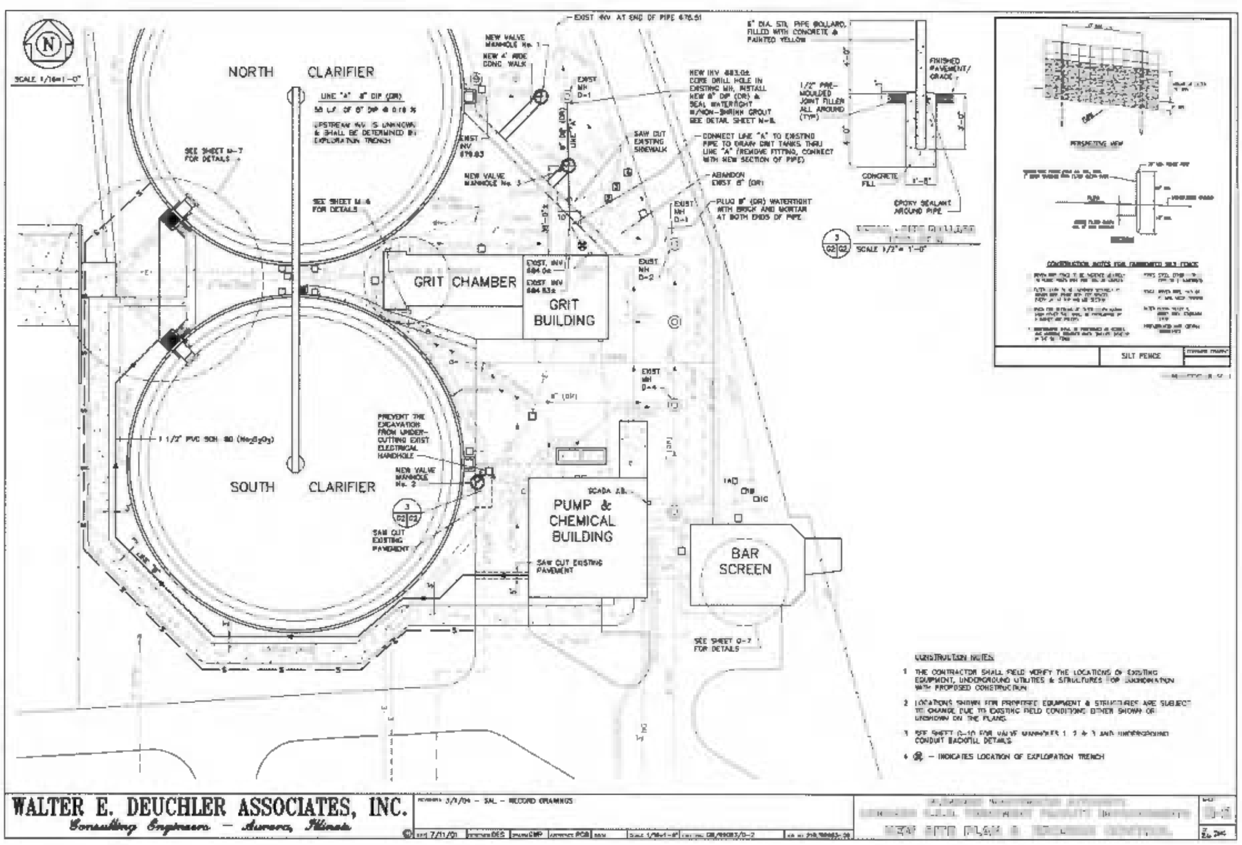
4.3 EFFLUENT REQUIREMENTS

4.3.1 NPDES PERMIT LIMITS (IL0022471)

The Authority's most recent NPDES permit for the CSO Facility is effective as of September 23, 2015. The discharge limits as outlined in this permit (Permit No. IL0022471) are presented below:

BOD_5	
Monthly Average, mg/L	Report
Suspended Solids	
Monthly Average, mg/L	Report
Fecal Coliform	
Daily Maximum	400 per 100 ml
pH	
Range	6 - 9
Chlorine Residual	
Monthly Average, mg/L	0.75
Total Phosphorus (as P)	
Monthly Average, mg/L	Report

** Report the number of days of discharging, as well as the total flow in million gallons.*



4.4 CSO INFLUENT DATA SUMMARY

The Authority typically only utilizes the CSO facility during large (total rainfall) or long sustaining (several day) wet weather events. Due to the variability of weather patterns and storms annually, use of the facility varies on a yearly basis. However, using the last two years of data, the facility is utilized an average of approximately 30 times each year.

The type of storm that occurs can affect the Authority differently. Larger storm systems can deliver high amounts of rainfall over a short amount of time. This type of rainfall sends a wave of flows to the treatment facilities and flows can spike very quickly. On the other hand, storms that last several days can be equally problematic, as this can cause saturated ground conditions and precipitation then has nowhere to go. This is typically when the facilities see a steady rise in flows that peak and maintain that level for several days.

Each discharge that occurs from the facility is dependent on the size and scale of the wet weather system that occurs. Therefore, when looking at the effluent data from the facility, it can span over a large flow range. This facility has operated at flows from 1 MGD to 46 MGD. Within the last two years the facility has operated as high as 80% of its design capacity. The table to the right identifies the three largest discharges in 2017 and 2018 from the CSO facility via Outfall 001.

Date	Rainfall (in)	Flows (MGD)
10/15/17	3.16	46.04
05/02/17	1.06	39.9
03/31/17	0.58	31.26
02/21/18	0.93	46.13
06/22/18	1.85	26.92
06/23/18	0	26.92

4.5 NPDES PERMIT EFFLUENT LIMITS

The Glenbard Wastewater Authority operates under the terms and conditions of its National Pollutant Discharge Elimination System (NPDES) Permit, which regulates the discharge of pollutants of concern in the facility's effluent flow. The current NPDES Permit was last modified on September 23, 2015 and has an expiration date of August 31, 2020.

As stated previously, this facility is not routinely used and operates approximately 30 times per year. Historically, this facility has been compliant with the issued NPDES permit and has not had any violations. However, during the last two years the facility has three NPDES permitted e with respect to their fecal coliform limit, as shown in Table 4-1. The facility currently utilizes liquid sodium hypochlorite as its method of disinfection, which degrades in concentration over time, as well as being impeded by ammonia and other organic compounds. Therefore, disinfection methods should be reviewed for this facility.

Table 4-1: CSO NPDES Permit Excursions

Date	Violation	Permit Level	Reported Results
April 30, 2017	Fecal Coliform	400 Fecal Coliform/100 ml	756 Fecal Coliform/100 ml
October 13, 2017	Fecal Coliform	400 Fecal Coliform/100 ml	TNTC Fecal Coliform/100 ml
October 14, 2017	Fecal Coliform	400 Fecal Coliform/100 ml	TNTC Fecal Coliform/100 ml

4.6 UNIT PROCESS REVIEW

4.6.1 RAW SEWAGE SCREENING

IEPA Regulatory Requirements

Screening Devices are regulated under the provisions of Title 35: Subtitle C: Chapter II: Part 370.610 Illinois Recommended Standards for Sewage Works.

Mechanical Screens: Clear openings for mechanically cleaned screens may be as small as practical to assure the proper operation and maintenance of treatment facilities. Mechanical screens shall be located so as to be protected from freezing and to facilitate maintenance.

Design Data

Design Parameter:	
Number of Screens	2
Type	Bar
Spacing, inches	2”
Number of bars per screen	55
Screen width, feet	15
Firm Capacity (One out of service), MGD	58
Unit Capacity, MGD	58

Description

Influent raw sewage is screened through one 2-inch mechanical rake coarse bar screens and a manual bypass bar screen with 3.25-inch spacings. The screens collect rags, sticks, plastics and other non-biodegradable debris in the incoming wastewater. Large grit and debris can interfere with treatment processes and upstream pumping facilities, as well as create unnecessary mechanical wear and increased maintenance on downstream equipment.

The two screens were first installed and placed into operation in 1982 and are 26 ft tall, base to deck, and 15 ft wide. One of the screens is mechanically cleaned with a traveling rake. This screen is a catenary curve design, meaning it has no lower sprocket. Material is raked to the top of the screen and discharged into a dumpster and transported to landfill. The mechanical screen is the primary screen, while the manual bar screen is utilized during extreme events, or bypass situations. A fixed overflow is set by a stop-log penetration between the two screen channels.

Prior to 2001, the existing structure consisted of two separate wet wells, however as part of the improvements a hole was sawcut into the existing structure to allow for a bypass. The Authority has the option to install stop logs to close off flows in-between each structure if required. Since the structure modifications, the only rehabilitation that has occurred was to the mechanical screen in 2009.

Performance and Deficiencies

The bar screens were last replaced in 1982 and the mechanical screen is in poor condition as it has reached the end of its service life. Each screen is capable of handling a large capacity of flows. However, the bar spacing is rather wide and can allow debris to pass that can contribute to downstream mechanical problems. If the hydraulics allow, a finer screen could be installed to allow for the removal of additional debris. This would help protect the downstream processes from large debris and grit/rocks. However, this may require more frequent dumpster hauling. A condition assessment table for the grit removal equipment is included below.

Table 4-2: Influent Screening Condition Assessment

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Bar Screen Building						
Catenary Bar Screen #1	E&I Corp	-	Poor	1982	20	2002
Manual Bar Screen #2	E&I Corp	-	Fair	1982	30	2012

Recommendations

The two existing influent screens have reached the end of their service life. Due to this structure being a critical step in the treatment process, it is recommended that the mechanical screen be replaced within the next 5-years of the CIP program. The bypass screen is not regularly operated and doesn't have any mechanical parts. Therefore, replacement is not necessary at this time; overall the manual bar screen is in fair condition and may provide a further 10 years of useful service life.

There are many options for screening equipment, including the increasingly more common fine screens. True fine screens may not be practical for this facility due to minimal operator oversight, however a clear opening smaller than the existing 2-inch is recommended. Through the reduction of the clear opening of the replacement screens, the Authority would remove a larger quantity of debris, and it would potentially help with wear and tear on downstream equipment such as the raw sewage pumps and grit system. It is recommended that a hydraulic evaluation be performed on the influent structure to identify the hydraulic limitations and constraints of the existing and proposed screen.

The existing bar screen facility is an open structure that is open to the elements and is subject the freeze and thaw cycles. Due to the infrequent operation of this equipment/facility the exposed equipment has the potential to freeze in position. Enclosure of the screening structure may warrant further review during conceptual design of any improvements. **It is recommended that the Authority plan to replace the mechanical bar screen within the 5-year CIP.** Each of the different projects outlined for the CSO facility have been incorporated into a single Capital Improvements Project, outlined in Section 4.8.

4.6.2 RAW SEWAGE PUMPING

IEPA Regulatory Requirements

Raw Sewage Pump Stations are regulated under the provisions of Title 35: Subtitle C: Chapter II: Part 370.400 Illinois Recommended Standards for Sewage Works.

Multiple pumps or ejector units shall be provided units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak flows.

Pumps handling raw sewage shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter.

Design Data

Influent Pumps Design Criteria	
Number	4
Type	Mixed Flow-Centrifugal
Capacity per Pump, MGD	19.3 MGD at 33 feet TDH

Description

After wastewater has flowed through the coarse bar screens, it enters the raw sewage pump wet well. The CSO Facility utilizes four raw sewage pumps with a capacity of 19.3 MGD, at 33 feet of head. The raw sewage pump station was constructed to handle 58.0 MGD and has not been significantly modified since installation. Pump control is based on influent wet well level; as the wet well level increases pumps are brought online and pumps are removed from service as flows subside. The control system was developed to assign lead/lag positions for each pump, this allows each pump to see similar run times and to balance the overall wear on the equipment.

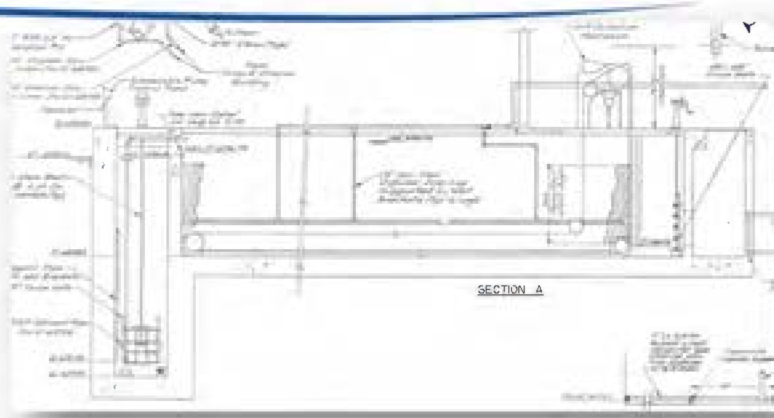
Performance and Deficiencies

The raw sewage pumps are original to the treatment facility and were rehabilitated in 2001. Overall, they are in fair condition and have not had any operational issues. The typical expected service life for these pumps is approximately 25 years, as the pumps are original to the facility's 1977 construction, they have exceeded their service lives. However, due to the large capital expenditures that are required in the next 10-years and the excellent maintenance program that has been implemented it is recommended that during the following facility planning period, the pumps be reviewed for replacement. Currently the pumps are not on VFDs. The Authority may consider installing VFDs in order to operate each pump over a wider range of flows. Through the use of VFDs, the Authority may realize energy cost savings with a potential for grant funding. However, this would need to be evaluated due to the minimal amount of run time the pumps see each year. The condition assessment table for the Raw Sewage Pump Building is included on the following page.

Table 4-3: Raw Sewage Building Condition Assessment

	Condition	Installation Year	Service Life	Replacement Year
Raw Sewage Pump #1	Fair	2001	25	2026
Raw Sewage Pump #2	Fair	2001	25	2026
Raw Sewage Pump #3	Fair	2001	25	2026
Raw Sewage Pump #4	Fair	2001	25	2026
Raw Sewage Pump Motor #1	Good	2001	25	2026
Raw Sewage Pump Motor #2	Good	2001	25	2026
Raw Sewage Pump Motor #3	Good	2001	25	2026
Raw Sewage Pump Motor #4	Good	2001	25	2026
Sodium Hypochlorite Feed Pump #1	Fair	2004	15	2016
Sodium Hypochlorite Feed Pump #2	Fair	2004	15	2016
Dechlorination Storage Tank #1	Good	2004	30	2034
Dechlorination Storage Tank #2	Good	2004	30	2034
Raw Wet Well Drain Pump #1	Fair	2018	25	2043
Raw Wet Well Drain Pump #2	Fair	2018	25	2043
Dechlorination Feed Pump #1	Fair	2004	15	2019
Dechlorination Feed Pump #2	Fair	2004	15	2019
Hypochlorite Storage Tank #1	Good	2004	30	2034
Hypochlorite Storage Tank #2	Good	2004	30	2034
Hypochlorite Storage Tank #3	Good	2004	30	2034
Hypochlorite Storage Tank #4	Good	2004	30	2034

4.6.3 GRIT REMOVAL



Flows from the raw sewage pump station is conveyed to one of two aerated grit systems. Each grit channel is rated for 29 MGD. The purpose of grit removal is to remove heavy inorganic material such as sands, small rocks, and larger debris that could otherwise settle and plug process piping. Excessive amounts of grit can also damage close-tolerance equipment such as pumps.

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.620 Illinois Recommended Standards for Sewage Works for aerated grit removal systems.

The inlet shall be located and arranged to prevent short circuiting to the outlet and oriented to the unit flow pattern so as to provide for adequate scouring segregation of grit materials prior to discharge.

A detention time of at least 3 minutes at design peak flow should be provided.

Air should be supplied at 5.0 cubic feet per minute (cfm) per foot of tank length. The rate of air supplied shall be widely variable so as to maximize unit process effectiveness.

Description

Influent flows enter the eastern side of the building from the raw sewage pump station and enter the aeration grit tanks. Air is diffused at the bottom of the tanks to help generate a circular/vortex type flow pattern. This flow path in general causes grit to settle out of the flows and end up at the bottom of the tank, while the organics stay in suspension. The grit is collected at the bottom of the tank via a chain and bucket system, dewatered, and disposed of at a landfill. The grit system is drained in between uses, preventing continual contact with wastewater, and overall increases the overall service life of the system.

Design Data

Design Parameter:	
Number of Units	2
Design	Aerated
Peak Flow, MGD	29
Tank length, ft.	64
Tank width, ft.	9.5
Side Water Depth, ft	11.92
Volume (Each), gallons	54,200
Total Volume, gallons	108,400
Detention Time, minutes	2.69

Performance and Deficiencies

The existing aerated grit system was installed as part of the 1977 plant construction, and new buckets, chains, shafts, and conveyors were installed in 2001. In 2004, the treatment facility was modified and chemical (hypochlorite) dosing equipment and tankage was added. The existing buckets and chains were rehabilitated in 2018. The existing grit conveyor is in fair condition and was replaced within the last few years.

Due to the environment that this equipment is in and the service conditions that are experienced during operation, the equipment is anticipated to have a service life of approximately 15 years. Therefore, the equipment has reached the end of its service life. However, due to the routine maintenance, and recent rebuilds that have taken place, it is recommended that this process be maintained as is and reevaluated as part of the next facility plan. In addition, the overall detention time for the system is below the recommended duration of 3 minutes.

Recommendations

Within the 2013 Facility Plan, the proposed improvements included replacement of the existing grit removal system with a vortex grit system. The proposed improvements include modifications to the existing channels, as well as the construction of two new CIP circular grit chambers. The proposed improvements had an overall anticipated capital cost of $2.5 Million in 2011 dollars (approximately $3.1M in 2018 dollars).

However, due to the condition of the equipment due to recent rebuilds, it is not necessary to replace the equipment at this time. The existing system has been rebuilt over the last several years and the only equipment that is original are the blowers. The grit system blowers should be scheduled for replacement as they are beyond the end of their service life, although their infrequent operation has prolonged their lifespan. The Authority has purchased a spare blower that is currently in storage, and could be installed if one of the existing blowers fails. **It is recommended that the Authority plan to replace the grit equipment within the 5-year CIP.**

Table 4-4: Grit Removal Building Condition Assessment

	Condition	Installation Year	Service Life	Replacement Year
Grit Aeration Blower #1	Fair	1977	30	2007
Grit Aeration Blower #2	Fair	1977	30	2007
Grit Collector #1	Fair	2001	15	2016
Grit Collector #2	Fair	2001	15	2016
Grit Conveyor	Fair	2001	15	2016
Raw Flow Meter - 30"	Good	2010	15	2025

4.6.4 Excess Flow Clarifiers

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.710 Illinois Recommended Standards for Sewage Works.

The maximum surface settling rate shall not exceed 1,800 gallons per day per square foot based on peak hourly flow. Minimum liquid depth shall not be less than 10 feet. Minimum detention shall not be less than one hour. The minimum length of flow from inlet baffle to outlet should be 10 feet, unless special provisions are made to prevent short-circuiting.

Description

Effluent from the grit chamber is hydraulically split and conveyed to the final clarifiers via two 42-inch cast iron pipes. Flow is discharged into each clarifier within the 10 ft diameter stilling wells at the center of the basin, flocculates, and settles downwards. From there, solids are settled to the bottom of the basin while clarified effluent flows over the effluent weirs. Final effluent is dechlorinated prior to being discharged to the receiving stream. The two existing clarifiers were constructed in 1977, are 145 feet in diameter, and have a 10-ft sidewater depth.

Solids that settle out are collected via a rotating sludge rake, drained from the tank, and ultimately sent to the main treatment facility for treatment. Solids are conveyed from each clarifier to the NRI on the northern end of the CSO facility site.

Design Parameter	
Design Flow, MGD	58.0
Number of Tanks	2
Diameter, ft.	145
Sidewater Depth, ft.	10
Surface Area, sf/clarifier	16,513
Total Surface Area, sf	33,026
Surface Loading Rate, gallons/sf	1,756
Weir Length – Each, lin. ft.	431
Weir Length – Total, lin. ft.	862
Weir Loading Rate, gpd/ft	67,285

Performance and Deficiencies

Based on the original construction drawings from 1977, the clarifiers were designed to have two-sided weir troughs with a total weir length of approximately 16,120 lineal feet. However, currently the existing clarifiers only have single sided weir troughs (modified to concrete outboard launders in 2011). Therefore, the total weir length is only half of the original design. As a result, the overall loading to the weirs is essentially double the recommended 30,000 gpd/ft.

Since their original installation, the clarifier mechanisms have been well maintained and refurbished over the years. A structural assessment by Walker Process in 2013 found that the mechanisms would likely require rehabilitation in the near-term due to several components nearing the end of their service life. In 2013/14 the Authority replaced the clarifier drives, center tubes, and collector cages.

The condition assessment table for the clarifier equipment is included below.

Table 4-5: Clarifier Equipment Condition Assessment

	Condition	Installation Year	Service Life	Replacement Year
CSO Clarifier #1 Collector	Fair	1977	25	2002
CSO Clarifier #1 Drive	Good	2013	25	2038
CSO Clarifier #1 Motor	Fair	1977	25	2002
CSO Clarifier #2 Collector	Fair	1977	25	2002
CSO Clarifier #2 Drive	Good	2013	25	2038
CSO Clarifier #2 Motor	Fair	1977	25	2002

Recommendations

Due to the significant capital cost associated with replacing the clarifiers in their entirety, as well as taking into consideration the available service life of the existing clarifier structures, it is recommended that the Authority rehabilitate the existing clarifiers versus full replacement. It is estimated that the concrete structures have approximately 30 years of remaining service life.

While the clarifiers are overloaded, the overall effluent quality has not been an issue. In addition, the existing facility is seldomly utilized for full effluent discharge. It is recommended that the rehabilitation of the clarifiers at this time only include blasting and painting the existing steel mechanism structure. The existing structure is in fair condition, and is not currently in need of full replacement.

However, within the next 10 years it is recommended that the mechanisms be revaluated. A budgetary cost for replacing the mechanisms would be approximately $275,000 each. Rehabilitation of the CSO clarifiers would include replacement of all clarifier mechanisms and components, bridge, and modifications to the sludge conveyance system to allow for easier cleaning and maintenance. However, the project would not include the replacement of the weirs and concrete launders due to their recent replacement. During the design of the clarifier rehabilitation project an evaluation of the weirs and hydraulic operation should be studied to identify if there is a flatwater condition during maximum flow events. At that time, a determination could be made to replace the weirs if necessary, depending on both the remaining useful life, and hydraulic conditions.

Another option for consideration for full replacement would be replacement of the existing clarifier mechanisms with a flocculating clarifier such as a UniMix Clarifier system manufactured by Walker Process. Flocculating clarifiers are similar to conventional clarifiers; however they typically have a larger diameter stilling well, mechanical mixers, and incorporate some type of chemical addition. The mixers are installed within the flocculation well to promote floc particle collisions and better settleability. As a result, the effluent quality of the flocculating clarifiers is significantly increased in regard to BOD and TSS. However, due to the variability in flow rates and loading rates to the clarifiers a conceptual design should be completed prior to proceeding with design.

During the site walk through, it was noted that solids from previous wet weather event were still in the bottom of the CSO clarifiers. Although the dried solids didn't present any odors during the walkthrough, there may be the potential for odors immediately after the tanks have been drained. Therefore, the Authority may want to consider installing a slide gate in the effluent box for each of the clarifiers, as well as making a connection to a water source to have the ability to fill the clarifier launders. This would allow the Authority to close the slide gate after a wet weather event, fill the launders with water, and proceed to backflow over the weirs back into the clarifier. This could assist the Authority with cleaning out the clarifiers after a wet weather event and move the solids at the bottom of the tank to towards the drain, and ultimately conveyed back to the GAWTF for treatment.

At this time, it is recommended that the Authority plan to blast and paint the existing mechanisms within the 5-year CIP. Each of the different projects outlined for the CSO facility has been incorporated into a single Capital Improvements Project. The opinion of probable project cost is included in section 4.8.

4.6.5 Effluent Disinfection

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part and 370.1020 and Illinois Recommended Standards for Sewage Works.

After thorough mixing, a minimum contact period of 15 minutes at design peak hourly flow or maximum rate of pumpage shall be provided.

Sodium hypochlorite systems shall be designed to have a capacity adequate to produce an effluent that meets the applicable chlorine residual effluent limits. Where necessary to meet the operating ranges, multiple units shall be provided for adequate peak capacity and to provide a sufficiently low feed rate on turn down to avoid depletion of the dissolved oxygen concentrations in the receiving waters. The system shall be designed on a rational basis and calculations justifying the equipment sizing and number of units shall be submitted for the entire operating range, including the minimum turn down capability for the type of control to be used. System considerations shall include the sensitivity and location of the controlling sewage flow meter, the telemetering equipment and pump controls.

The design dosage rate of the equipment shall be based on the particular dechlorinating chemical used and the applicable residual chlorine limits. The following theoretical amounts of the commonly used dechlorinating chemicals may be used for initial approximations to size feed equipment.

Dechlorinating Chemical	Theoretical Dosage Required to Neutralize 1 mg/l Cl_2 (mg/l)
Sulfur dioxide (gas)	0.90
Sodium meta bisulfite (solution)	1.34
Sodium thiosulfate (solution)	2.23
Sodium bisulfite (solution)	1.46

The design shall take into account the fact that under good mixing conditions approximately 10% more dechlorinating chemical than theoretical value is required for satisfactory results.

Description

From the clarifiers, effluent is discharged from the facility via Outfall 001 and into the East Branch of the DuPage River. The Authority's Facility uses sodium hypochlorite (liquid chlorination) and sodium thiosulphate dechlorination to meet final effluent fecal coliform requirements. Sodium thiosulphate is the most commonly used chemical used for dechlorination since it is less hazardous and consumes less dissolved oxygen (DO) from the water than sodium bisulfite. Dechlorination occurs as the effluent from the clarifiers travels over the weirs into the effluent troughs. The plant's permit requires the final effluent to reach a fecal coliform count of less than 400 per 100 mL sample.

Performance and Deficiencies

The existing chlorination/dechlorination system was installed in the early 2000's and is approximately 15 years old. This equipment has been regularly maintained and is in good operating order. One concern that has occurred in the past includes, freezing of the hypochlorite feed line during extreme winter conditions. When this occurs, a temporary line is run over the road to allow for chlorination. Additionally, there have been three excursions in effluent fecal coliform counts over the last year. Therefore, the existing system should be evaluated to identify potential improvements.

The Authority uses sodium thiosulfate for dechlorination before discharge. While there are four large sodium hypochlorite tanks at the CSO facility, there are only 2 sodium thiosulphate tanks that occasionally are at risk of running empty before the facility is resupplied. Adding a third redundant sodium thiosulphate storage tank would reduce the likelihood of the facility ever running out of the dechlorination chemical. The area where the two existing tanks are located may support the installation of a third tank. It is recommended that the Authority consider the installation of the third storage tank.

Currently the Authority utilizes liquid sodium hypochlorite, as it is easier and safer to use than gaseous chlorine. However, sodium hypochlorite degrades over time, becoming weaker. As a result, as the disinfecting agent is held throughout the year it takes more material to disinfect the same volume of water. This presents challenges in accurately dosing without a known concentration. Additionally, dosing upstream of clarification results in a significantly higher base demand attributed to solids and organic competition. With a variable influent loading, dosing the correct amount of hypochlorite becomes even more difficult. The violations that occurred could be a direct result of the decomposition of the solution and variable influent loading. An evaluation of other disinfection methods such as onsite hypochlorite generation, the use of tabular/granular disinfection methods, or even the use of peracetic acid should be completed.

Onsite Sodium Hypochlorite Generation

Onsite production of sodium hypochlorite constitutes a higher capital cost, but a lower operational cost compared to delivery of sodium hypochlorite. A multi-cell system electrolyzes a brine solution to produce sodium hypochlorite with a concentration of 0.8%, below the hazardous material threshold. The ingredients used for onsite generation are common salt, water, and electricity. 15 gallons of water are used to produce 1 lb of free available chlorine. The lower concentration of NaOCl also has a lower pH, reducing scaling and disinfection byproducts. However, the high quantities of water and salt used by the process may be prohibitive, and the consumption of common salt could introduce chloride concerns in the effluent flow. Lastly, onsite generation of sodium hypochlorite produces a product with a lower concentration than conventional delivered NaOCl, so it may not be potent enough to provide a total coliform kill under the limited detention times available during high flow events.

Peracetic Acid

Peracetic acid is typically delivered as a composition of acetic acid (15% by weight), hydrogen peroxide (23%), peracetic acid (16%), water (>45%), and a catalyst (<1%). The solution will maintain its equilibrium for more than a year if stored properly. Peracetic acid and hydrogen peroxide decompose naturally with a temperature-driven rate. Therefore, proper storage includes protection of the material from contaminants and maintaining temperatures below 85 °F. A basin would be constructed or purchased prefabricated for chemical storage and containment, presenting concerns over the space required for this alternative. A fork lift would be used to maneuver chemical totes.

Tabular Disinfection

Tabular disinfection consists of dissolving disinfecting chlorine tablets into the effluent water. This method is advantageous in that the tablets are relatively inexpensive and easy to apply during high flow events but comes with a number of drawbacks. Dosing is more difficult than a direct feed system as the tablets are sized to treat a particular volume of water. Additionally, the tablets are not well suited to the variable detention times that are frequently displayed when the CSO is in operation.

Recommendations

There are several different options that are available for disinfection, however continued use of the hypochlorite method may be the most practical for the Authority at the CSO facility. This is largely due to the relatively inexpensive costs of the hypochlorite chemical, as well as the high capital costs and/or maintenance costs of the other methods of disinfection such as UV, tabular, and onsite generation. In addition, the large flow range for some of these systems could prove to be problematic. However, the existing disinfection system can be upgraded to provide a more robust and reliable system.

The first recommendation would be to install an online chlorine residual analyzer upstream of dechlorination. This would allow the Authority to monitor the effluent and increase the dosage as required. In addition, as the hypochlorite degrades, a better gauge on the effluent quality could be made.

Second, it is recommended that this analyzer be tied back to the SCADA system to allow for the operational control of the dosing pumps. Through this connection, the hypochlorite pumps would increase their dosing rates as required, or vice versa. The drawback to this system is that if insufficient residual is detected, the effluent cannot be re-dosed prior to discharge and a violation is risked.

In order to counteract these chlorination issues, several instrumentation and control upgrades are recommended which may assist in more accurate disinfection. An online hypochlorite concentration sensor, such as Wallace & Tiernan's Depolox line, can indicate whether the solution is degrading. Logic in the disinfection controller can calculate the additional solution required at the reduced concentration to ensure a consistent dosage is applied. Further, an upstream ORP and/or TSS probe at the influent to the grit channels can indicate the relative chlorine base demand attributed to solids and organics in the raw wastewater. This may allow for increased dosage to accommodate the shielding of embedded bacteria by TSS. **It is recommended that the Authority plan to implement the disinfection control upgrades within the 5-year CIP.** Each of the projects outlined for the CSO facility have been incorporated into a single Capital Improvements Project. The opinion of probable project cost is included in section 4.8.

4.6.6 Excess Flow Lagoons

In addition to the primary CSO facility which can discharge through Outfall 001, the Authority has Outfall 002 for extreme events. Outfall 002 is very rarely used; however, it gives the Authority another option when influent flows to the CSO facility are greater than 58.0 MGD. At the point when the flows increase above 58.0 MGD, flows are diverted to the two lagoons which have a treatment capacity of approximately 14.5 MGD.

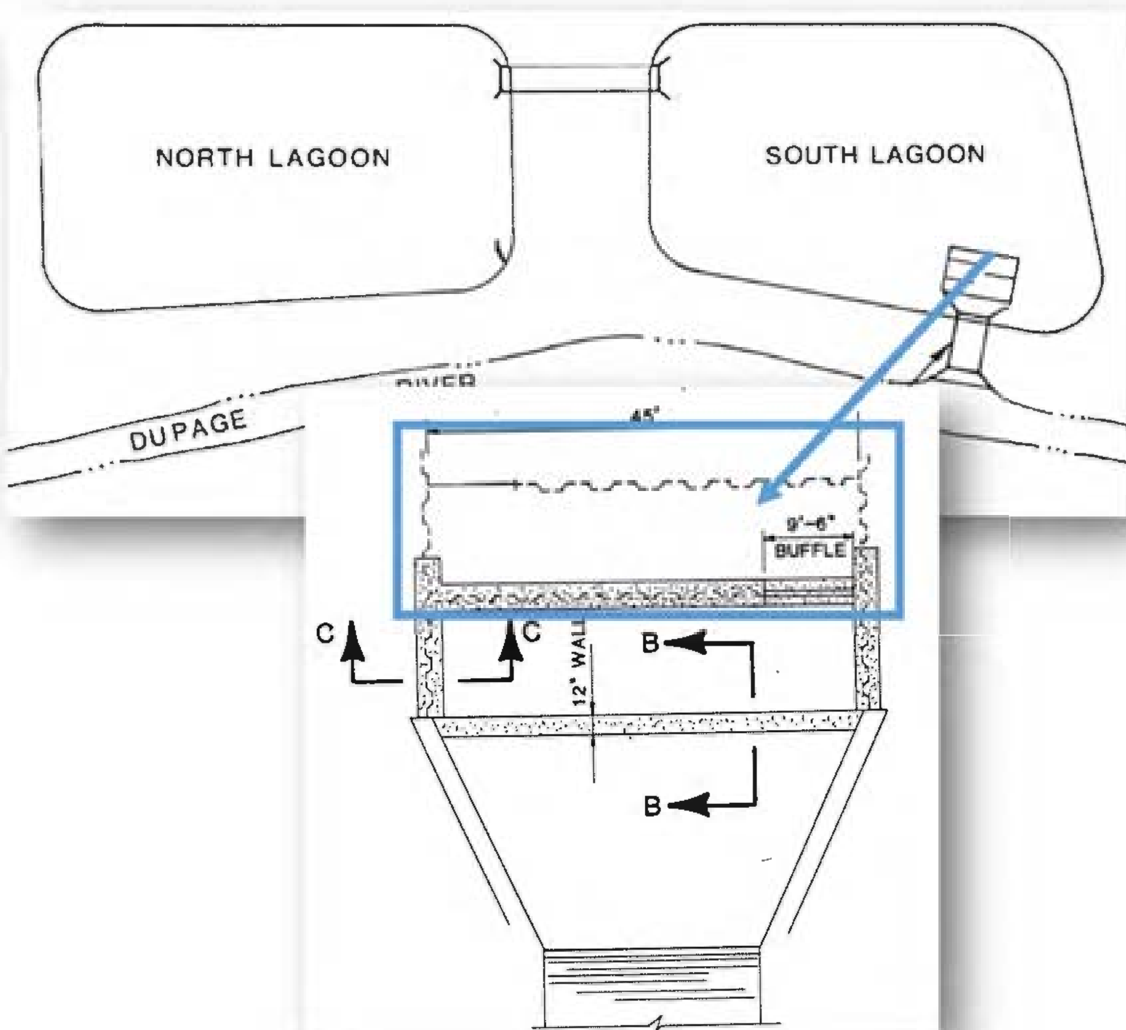
The Authority has several options when utilizing the lagoons. If the flows are sustained, the lagoons will fill and eventually discharge from Outfall 002 to the stream. However, as flows subside, a valve is manually opened and flows will be drained back into the NRI. In either scenario, when utilizing this facility the Authority monitors the wastewater and collects samples throughout the discharge.

The lagoons can also be used as a buffer for the CSO and Main treatment facility. The Authority can first fill these lagoons, and not discharge during extreme events. The lagoons can be utilized to store wastewater until the storm has passed, and then flows can be diverted to the CSO or main facility to receive treatment.

Recommendations

The two excess flow lagoons are currently interconnected via a single 154" x 100" arch pipe. This pipe is utilized to convey flows from the north to the south lagoon. Once the lagoons have filled to an elevation of the effluent weir (elv. 686.42'), flow is discharged to the DuPage River. As part of the original design and construction of the two lagoons, the south lagoon had an effluent structure constructed. The effluent box included a concrete structure, weir, and baffle walls.

The baffle walls in the original construction were utilized to create an underflow from the lagoon prior to discharge to the DuPage River. This underflow was developed to help inhibit the effluent structure from being blocked with debris. Floating debris within the lagoon would be blocked on the backside of the baffle, while flows are conveyed under the baffle and out the effluent structure. The baffles that were constructed consisted of corrugated metal and have reached the end of their useful life. It is recommended that the baffles be removed and replaced within the 10-year planning period. This project is not a priority at this time as the lagoons are rarely used. The Authority should plan on addressing this as part of another routine maintenance project.



4.7 CONCLUSIONS AND RECOMMENDATIONS

The Combined Sewer Overflow (CSO) facility owned by the Glenbard Wastewater Authority generally uses components original to its 1982 construction, and as such much of the equipment is nearing 40 years old. The relatively limited use has extended the service life of many components at the facility beyond what would typically be expected. However, it is recommended that the Authority schedule a number of the process for rehabilitation or replacement to prevent future failing of aging infrastructure.

In rehabilitating the CSO facility, the Authority should budget to replace the existing mechanical screen with a finer spacing. A finer opening will remove more debris and protect downstream processes from increased wear and tear. The existing bypass screen can continue to be maintained, and replacement is not required at this time.

The raw sewage pumps at the CSO plant are in good working condition and, but they have exceeded their expected service lives. These pumps have not been rehabilitated since 2001 and as such the Authority should budget for replacement of these in the 10-Year CIP. Additionally, installing VFDs at this facility could extend the lives of pumps by better optimizing pump performance. Electrical improvements could also include replacement of MCCs, as the existing units are original to the facility.

Grit facilities have likewise exceeded their expected service lives. Previous studies have recommended replacement of the system with a newer technology such as vortex removal systems with an estimated capital cost over $3.1M in 2018 dollars. However, due to the infrequent use of the facility it may not be necessary to significantly increase the grit removal efficiency at this significant of a capital expenditure. Additionally, the Authority has made several steps in replacing a large amount of the existing components. Therefore, the only items recommended for replacement would be the existing aeration blowers.

The existing clarifier equipment was structural reviewed by Walker in 2013, and several of the deficiencies identified have been corrected in the last few years. Therefore, due to the large CIP requirements at this time, as well as the infrequent operation, it is recommended that the existing clarifier mechanisms only be scheduled for blasting and painting. The replacement of weirs is not recommended at this time due to the existing condition and available service life. As part of the long-term plan, the clarifiers should be reevaluated during the development/update of the next facility plan. At that time, the Authority should consider the replacement of the existing clarifiers with a flocculating clarifier to increase the effluent quality of the facility.

Fecal coliform violations in the last year have made renovations to the facility's disinfection processes a top priority. The Authority should implement an online chlorine residual analyzer to assure that dosing of hypochlorite is at a level that will sufficiently disinfect effluent water. This analyzer should be tied into the facility's SCADA system, making the disinfection system more robust and responsive. Lastly, existing components of the disinfection system should be replaced as they have reached the end of their service lives, with the exception of the poly storage tanks. Additionally, a third sodium thiosulfate storage tank be added to the facility, during large rain events sodium thiosulfate storage can be a limiting factor.

In order to maximize the Authority's value at the CSO facility it is recommended that each of the outlined projects be integrated into a single CIP project. The opinion of probable project cost below outlines the overall project capital requirement, estimated at $2.4 million.

CSO Facility Capital Project	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$307,348
SITE WORK	$290,000
RAW SEWAGE SCREENING	$493,000
GRIT TANKS UPGRADES	$186,900
CSO CLARIFIERS	$160,000
CHLORINE DISINFECTION	$348,000
Construction Sub-Total	$1,785,248
Contingency @ 15%	$267,787
Engineering @ 15%	$307,955
PROBABLE PROJECT COST:	**$2,360,990**

4.8 CSO REGULATORY UPDATES

The USEPA has proposed legislation to address sanitary sewer overflows, combined sewer overflows and bypass treatment. It is recognized that overflows and bypass of the treatment system can have a significant negative impact on the receiving stream water quality. In anticipation of this rule, other State agencies have mandated the removal of excess flow facilities. However, Illinois EPA permitted its facilities with blending requirements and the current ruling states that treatment facilities must meet secondary effluent standards which correlates with the IEPA's 30/30 standards for BOD and TSS during wet weather events. Therefore, the USEPA and Illinois EPA have agreed to allow blending to continue in the State of Illinois for the time being. Similarly, dedicated CSO facilities have been permitted to remain in their current operation at this time. Many facilities have been required to complete a Long-Term Control Plan (LTCP) outlining control methods to maintain adequate effluent quality. Because the Authority's CSO facility had not experienced any NPDES violations, an LTCP has not yet been required. However, in light of on-going efforts by State and federal agencies to increase the treatment provided by CSO facilities, the Authority should evaluate methods to achieve compliance with more stringent BOD and TSS limits in the future.

As previously discussed, a flocculating clarifier such as Walker Process's UniMix process can provide additional solids and organics removal in the existing clarifiers. UniMix flocculators located within the large diameter stilling well provide low energy flocculation for agglomeration and removal of fine solids. The mixer speed can be modulated to meet changing conditions and provide maximum flocculation. UniMix clarifiers can be fitted with inlets which increase floc particle collisions, creating a more settleable slurry. The additional cost associated with the larger stilling well, flocculation zone mixers, and chemical dosing equipment is estimated to be approximately $100,000 per tank. This should be further reviewed during conceptual design of the CSO Facility Rehabilitation Project.

Figure 4-2: Walker Process: UniMix

A second alternative for solids removal is high-rate treatment systems, designed specifically for high-solids content, high flow applications such as CSO and excess flow facilities. The most common of these systems are Kruger/Veolia's Actiflo, Degremont/Suez's DensaDeg, and WWET/WesTech's WWETCO systems. The most advantageous of these for the Authority's CSO facility may be the WWETCO system, which does not require the significant chemical addition the Actiflo and DensaDeg Systems do, has significantly less maintenance associated with it, and does not require extensive operator oversight. The WWETCO process utilizes a compressible media filter to trap and remove particulate. The estimated capital cost of such a system is approximately $6.0M, based on TAI's recent site evaluation of a 100 MGD facility in Springfield, Ohio. This process would be located downstream of the existing clarifiers, and produce a higher quality effluent on a more consistent basis.

Figure 4-3: WWETCO: Flex Filter

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SECTION 5
EXISTING WASTEWATER TREATMENT FACILITY

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5. EXISTING WASTEWATER TREATMENT FACILITY

This section describes current conditions at the Glenbard Wastewater Authority's wastewater treatment facility. Current and future wastewater flows, and pollutant loadings are discussed, and each of the existing treatment unit processes is reviewed and assessed. The capacity and/or ability to meet current and future conditions is determined. The impact of additional flows from future development is evaluated and recommendations are provided ongoing system maintenance.

5.1 GENERAL BACKGROUND

In 1977, the Villages of Lombard and Glen Ellyn entered into an intergovernmental agreement which established the Glenbard Wastewater Authority (GWA) for the purpose of providing wastewater conveyance and treatment for both communities. The Glenbard Advanced Wastewater Treatment Facility (GAWTF) is owned and operated by the Glenbard Wastewater Authority and was constructed in 1977. Since construction the facility has had several improvements projects, however it remains operational similar to its original construction. The plant has the capability to treat a Design Average Flow (DAF) of 16.02 MGD and a Design Maximum Flow (DMF) of 47.0 MGD.

5.2 CURRENT TREATMENT PLANT PROCESS

The Authority's wastewater treatment facility removes contaminants from wastewater by physical, chemical and biological processes. The objective is to produce an effluent (liquid stream) that is environmentally safe to release into the East Branch of the DuPage River and a solid waste (or sludge) suitable for reuse as a farm fertilizer. Sewage treatment at the Authority's facility involves five stages; preliminary, primary, secondary, tertiary, and disinfection. Solids produced in the treatment process are stabilized and disposed of through land application. Liquid is discharged to the East Branch of the DuPage River.

5.2.1 Liquid Treatment Process

Influent flows tributary to the WWTP are first screened, and then pumped from the head of the plant on the east side of the property to the western side to receive grit removal. The screening process consists of automatically cleaned Mahr bar screens which remove large objects such as sticks, rags and other debris. The screening material is washed and compacted, ultimately disposed of in the landfill.

Once screened, flows are pumped to the grit building where wastewater is conveyed to two vortex grit tanks and grit classifiers to allow sand, grit and other heavy inorganic solids to settle to the bottom. Grit collected from the treatment processes are removed mechanically, collected, and disposed of in a landfill.

Following screening and grit removal, wastewater flows east to the primary treatment process. Primary treatment consists of sedimentation tanks in which heavy solids are removed through settling while scum floats to the surface. The solids on the bottom, called primary sludge, are collected using clarifier sweep sludge collectors. Primary sludge is drawn off the bottom of the clarifier and is transferred to a gravity sludge thickener, which is used to concentrate the sludge and remove excess water. Upon being thickened the solids are pumped directly to the anaerobic digesters for stabilization. The primary effluent flows over weirs and is conveyed to the secondary (biological) treatment process. Scum removed from the surface of the clarifiers is concentrated and discarded to a landfill.

The GWA has a relatively uncommon biological treatment process that utilizes a pure oxygen system for the treatment of wastewater, including both carbonaceous BOD and ammonia reduction. This system was installed as an innovative concept under the United States EPA grant program in the early 1980's. Primary effluent is blended with Return Activated Sludge (RAS) and treated in the first-stage aeration basins, which are located at the north end of the secondary treatment process. These basins utilize a combination of pure oxygen and mechanical mixers rather than typical aeration and mixing with air. An advantage of this design is that the basins are able to be loaded at higher concentrations than traditional facilities, resulting in significantly smaller basin tankage

The mixed liquor from the first-stage carbonaceous removal process is tributary to a pair of intermediate clarifiers located immediately east of the first-stage aeration basins. Return activated sludge (RAS) from the intermediate clarifiers is returned to the first-stage carbonaceous removal process, and waste activated sludge (WAS) is transferred to the gravity thickener.

Effluent from the intermediate clarifiers is blended with RAS from the final clarifiers and is pumped to the second-stage nitrification process via screw pumps. The second-stage nitrification process was constructed common-wall with the first-stage biological process and utilizes much of the same infrastructure.

Mixed liquor from the nitrification process is conveyed to four final clarifiers. These clarifiers utilize a peripheral feed/peripheral take-off configuration in conjunction with a hydraulic differential sludge removal mechanism. Sludge withdrawn from the final clarifiers is either returned as RAS to second stage nitrification or wasted to the gravity thickener and blended with primary sludge.

Effluent from the final clarifiers is conveyed to the tertiary disc filters for further solids removal, and disinfected via a UV system prior to discharge. These unit processes are located on the northeast corner of the GAWTF. The tertiary filters were recently converted from deep-bed sand filters to Kruger Hydrotech Disc Filters. Filtered effluent is disinfected through the use of ultraviolet (UV) technology. The GWA's current NPDES Permit allows for seasonal disinfection, therefore the UV system is not operated year-round. Effluent flows are discharged to East Branch of the DuPage River (Outfall 001).

5.2.2 Excess Flow Treatment Process

During wet weather events, influent flows to the plant that are greater than 2.5 times the dry weather flow are diverted by vortex regulators (which are located in diversion structure within the collection system) to a separate facility, the Combined Sewerage Overflow (CSO) facility. The CSO facility is located at 625 Hill Avenue in Lombard. This facility is unmanned and is operated only during significant wet weather events. The CSO facility was constructed in 1977, has been modified over the years, and was last rehabilitated in 2004. The CSO facility only operates as needed, and is generally during periods of significant rainfall with a peak design flow for the facility is 58.0 MGD. This facility is discussed in greater detail within Section 4 of this report. Two lagoons are also located at the Main WWTP. The 2013 estimated a cost of $361,000 to dredge the lagoons. The Authority has since chosen to fill the lagoons in (currently in progress). This will make the land available for future uses.

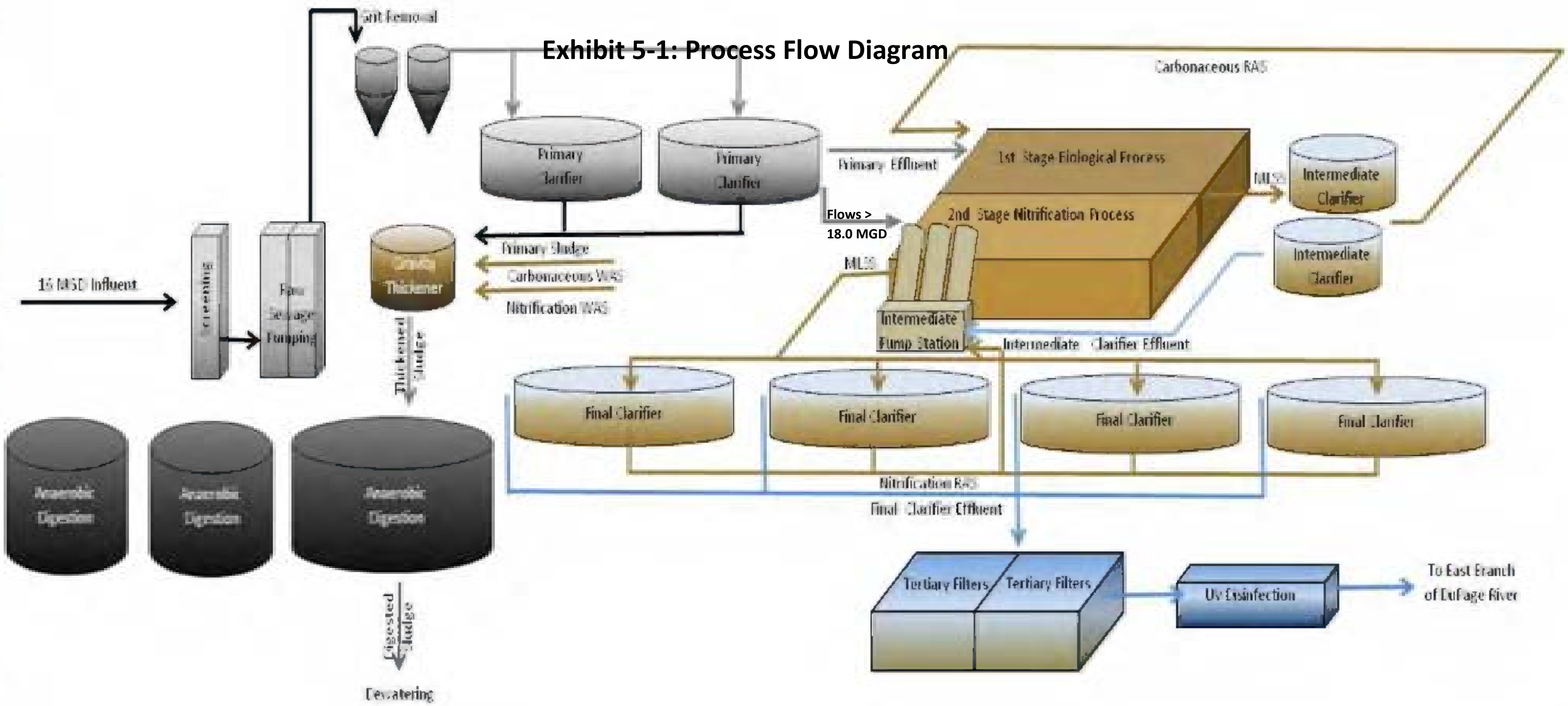
5.2.3 Biosolids Treatment Process

The biosolids, or sludge, produced in the treatment process must be treated and properly disposed. Both primary sludge and waste activated sludge must be stabilized in order to be land applied. Prior to stabilization, both primary and waste activated sludge are combined and co-thickened in a gravity thickener. Thickened sludge, or TWAS is pumped to two primary anaerobic digesters. Digested sludge from the primaries are transferred to the secondary for further processing.

Anaerobic digestion involves four steps in order to digest the sludge; hydrolysis, acidogenesis, acetogenesis, and methanogenesis. This process uses anaerobic microorganisms to break down complex proteins and sugars to water, carbon dioxide and methane. In order for the anaerobic digestion process to occur, the digesters must be maintained at a temperature of around 95°F.This produces a biogas byproduct, and stabilized sludge. The main component in the biogas is methane. The methane is used by boilers to provide supplemental heat and maintain the optimum sludge temperature. When additional heat is not needed, surplus biogas is burned off with a flare. Recent improvements have constructed a combined heat and power (CHP) system which allows for onsite power generation from burning excess biogas for the production of electrical energy.

Digested sludge is transferred to a secondary digester which also serves as a sludge storage tank. Polymer is added to the digested sludge, which is then dewatered across two belt filter presses and hauled for land application by a third-party. The sludge meets Class B sludge requirements for land application.

Exhibit 5-1: Process Flow Diagram



5.3 Current Design Loadings

Population Equivalent

Existing Residential, P.E	91,359
Existing Non-Residential, P.E.	16,377
Total Service Area, P.E.	107,736

Design Flows

Design Average Flow, MGD	16.02[1]
Design Maximum Flow, MGD	47.0 [1]

Design Dry Weather Wastewater Characteristics

TSS = 16.02 MGD x 240 mg/L* x 8.34 lbs/gal = 32,066 lbs/day
BOD_5 = 16.02 MGD x 204 mg/L* x 8.34 lbs/gal. = 27,256 lbs/day
NH_3-N = 16.02 MGD x 26 mg/L x 8.34 lbs/gal. = 3,474 lbs/day

*Illinois EPA minimum loading for organic design
0.20 lbs. TSS/PE/day / (0.0001 MG/PE/day x 8.34 lbs/gal) = 240 mg/L
0.17 lbs. BOD/PE/day / (0.0001 MG/PE/day x 8.34 lbs/gal) = 204 mg/L

<u>Note:</u>
1. Rated flow as determined by NPDES Permit No. IL0021547.

5.4 Loadings at Existing Conditions

Design Flows & Loadings

Average Flow (January 2013 – December 2017), MGD	12.80
Average Influent BOD_5 (January 2013 – December 2017), mg/L	172
Average Influent BOD_5 (January 2013 – December 2017), lbs/day	18,382
Average Influent TSS (January 2013 – December 2017), mg/L	214
Average Influent TSS (January 2013 – December 2017), lbs/day	22,865
Average Influent NH_3 (January 20115 – December 2017), mg/L	24
Average Influent NH_3 (January 2013 – December 2017), lbs/day	2,573

5.5 EFFLUENT REQUIREMENTS

5.5.1 NPDES Permit Limits

The Authority's most recent NPDES permit is effective as of September 23, 2015. This permit establishes a 1.0 mg/L monthly average on total phosphorus to be effective in the coming years. This is becoming a common limit across Illinois as the push to remove nutrients from the waterways is growing stronger. The discharge limits as outlined in this permit (Permit No. IL0021547) are presented below:

Flow	
Design Average Flow, MGD	16.02
Design Maximum Flow, MGD	47.0
BOD_5	
Monthly Average, mg/L	10
Monthly Average, lbs/day	1,336
Suspended Solids	
Monthly Average, mg/L	12
Monthly Average, lbs/day	1,603
Fecal Coliform	
Monthly Mean	400 per 100 ml *May through October
pH	
Range	6 - 9
Chlorine Residual	
Daily Maximum, mg/L	0.05
Ammonia Nitrogen	
April through October	
Daily Maximum, mg/L	3.0
Daily Maximum, lbs/day	401
Weekly Average, mg/L	none
Weekly Average, lbs/day	none
Monthly Average, mg/L	1.5
Monthly Average, lbs/day	200

November through February	
Daily Maximum, mg/L	7.5
Daily Maximum, lbs/day	1,002
Weekly Average, mg/L	none
Weekly Average, lbs.	none
Monthly Average, mg/L	3.3
Monthly Average, lbs.	441
March	
Daily Maximum, mg/L	12.4
Daily Maximum, lbs.	1,657
Weekly Average, mg/L	6.3
Weekly Average, lbs.	842
Monthly Average, mg/L	2.5
Monthly Average, lbs.	334

Total Phosphorus*

Monthly Average, mg/L	1.0
Monthly Average, lbs.	134

**The Permittee is instructed to participate in the DuPage River Salt Creek Workgroup (DRSCW). The Authority is instructed to work with other watershed members to determine a method of removing DO, chlorides, and phosphorus. The Authority is to develop a written Phosphorus Discharge Optimization Plan. The Authority will assist with DRSCW waterway projects and submit an annual progress report. Within 24 months of the issuing of the NPDES permit, the Authority will develop a timeframe and a construction and O&M cost estimate for phosphorus removal down to 1.0 mg/L, 0.5 mg/L, and 0.1 mg/L. Effluent monitoring will include total phosphorus, dissolved phosphorus, nitrate/nitrite, total Kjeldahl nitrogen (TKN), ammonia, total nitrogen (calculated), alkalinity, and temperature at least once per month. Influent monitoring for total phosphorus and total nitrogen is also required monthly. A Nutrient Implementation Plan (NIP) shall be submitted for the DRSCW watersheds.*

Total Nitrogen

Monitor Only

Dissolved Oxygen

March - July	
Weekly Avg, mg/L	≥6.0
Daily Minimum, mg/L	5.0
August - February	
Monthly Average, mg/L	≥5.5
Weekly Average, mg/L	≥4.0
Daily Minimum, mg/L	3.5

5.6 Current Influent & Effluent Wastewater Parameters

5.6.1 Influent Data Summary

Flow to the facility is monitored by influent and effluent flow meters, wastewater sampling units and on-site laboratory testing. The IEPA determines a treatment facility's remaining hydraulic capacity based on the average of the three low-flow months over the past 12 months. Below is a breakdown of the three-low flow months, annual average and peak month for the influent and effluent flow meters for 2015 through 2018.

Table 5-1: Three Month Low Flows

Year	Three Month Low Flow (MGD)	Months	Three Month Low Flow Average (MGD)
2015	8.44	October	9.27
	9.39	February	
	9.97	January	
2016	9.00	September	9.83
	9.77	November	
	10.72	July	
2017	7.35	September	7.76
	7.89	August	
	8.04	December	
2018	9.03	July	9.76
	9.77	August	
	10.49	January	

Title 35 of the Illinois Administrative code states that a sewer system has reached "Critical Review" status when the three-month low flow average exceeds 80% of the design capacity. Similarly, "Restricted" status occurs when a system reaches 85% of the design capacity. Based on the 2018 three-month low flow average, the Glenbard Wastewater Authority's Main Plant is at 61% of the design capacity.

The existing wastewater treatment plant is currently able to handle all flows and loadings that it receives on a daily average basis. Table 5-2 below shows that the average day data for 2013-2018 is well below the capacities of the existing facility. The average flow of 12.86 MGD is 80% of the design capacity, while the biological loading is just 67% of the facility's design.

Table 5-2: 2013-2018 Average Loading Conditions

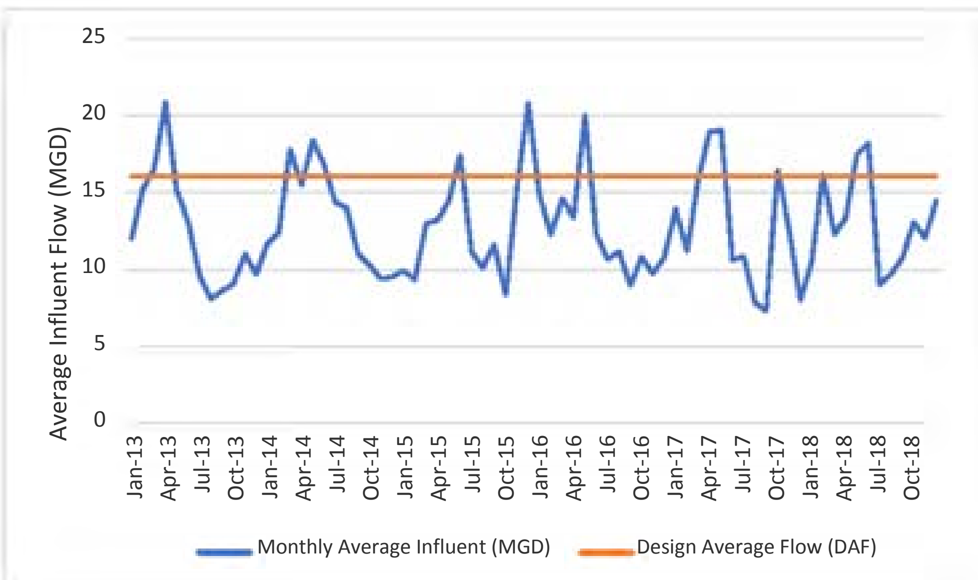
Parameter	Average Flow (MGD)	BOD_5 (lbs/day)	TSS (lbs/day)
Design Flow and Loading	16.02	27,256	32,066
Three Month Low-Flow and Loading (2013-2018 Average)	12.86	18,379	22,808
Current Loading (% of Design)	**80%**	**67%**	**71%**

The per capita water consumption was estimated at 83 gallons/PE by isolating demand from other sources such as infiltration and inflow. Using this value and the projected population growth within the FPA, it is estimated that the ultimate average demand at the GAWTF will be approximately 13.82 MGD. As shown in Table 5-3, this corresponds to a hydraulic loading of 86% and an organic loading of 72% of the facility's design capacity. It is not anticipated that the existing wastewater treatment facility will need to be expanded prior to ultimate buildout of 119,377 PE.

Table 5-3: Future Loading Conditions (Build-Out)

Parameter	Average Flow (MGD)	BOD_5 (lbs/day)	TSS (lbs/day)
Design Flow and Loading	16.02	27,256	32,066
Future Loading	13.82	19,760	24,522
Current Loading (% of Design)	**86%**	**72%**	**76%**

Figure 1: Daily Average Influent Flows (MGD)



The following charts, Figure 5-2 and Figure 5-3, illustrate the monthly average influent BOD_5 and suspended solids loading to the wastewater treatment facility from January 2013 through December 2018.

Figure 2: Daily Average Influent BOD Loading

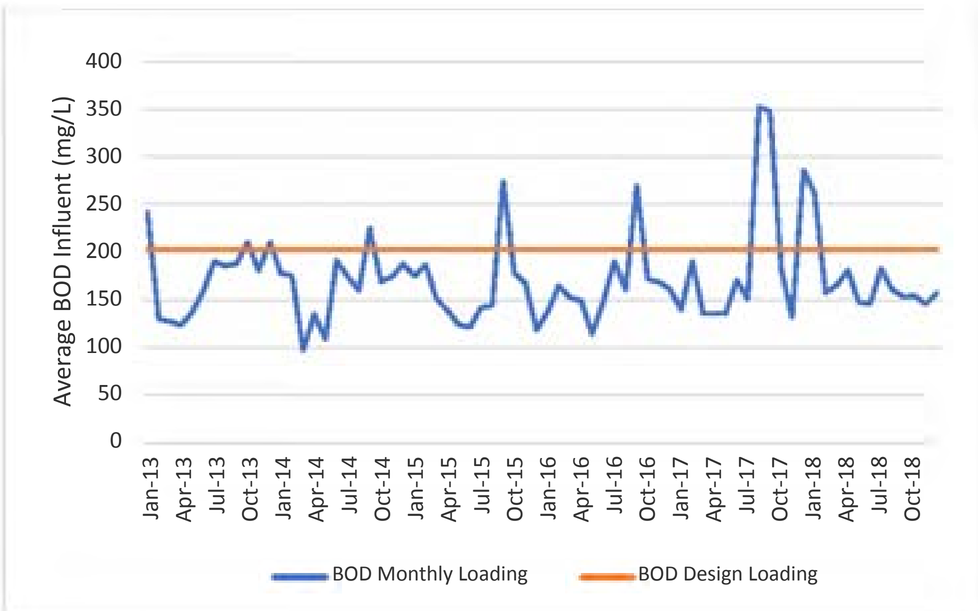
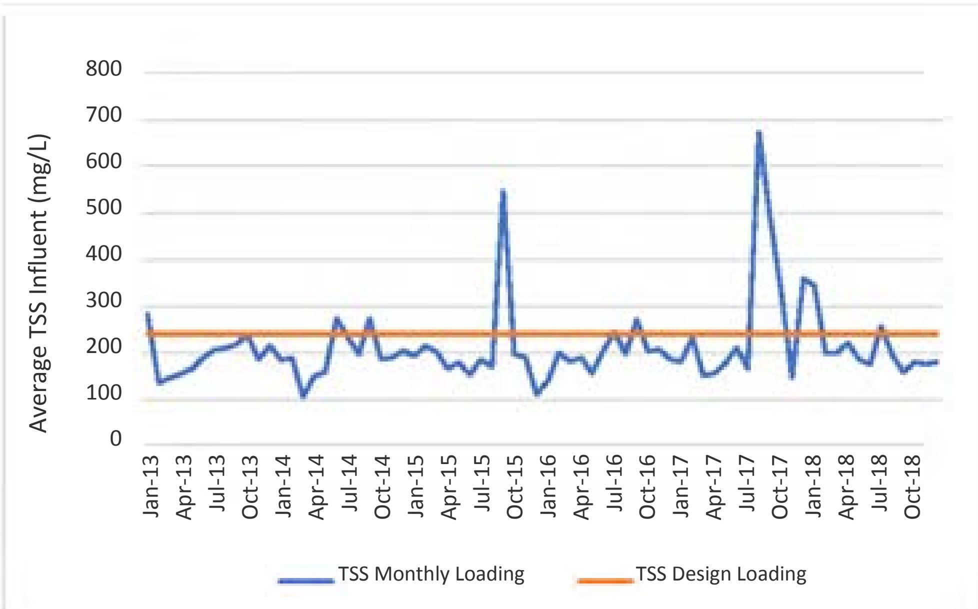


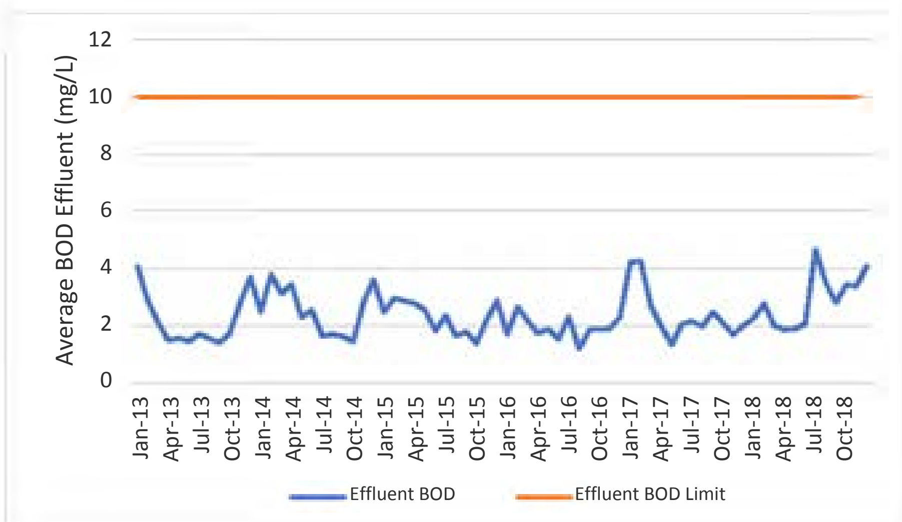
Figure 3: Daily Average Influent Suspended Solids Loading



5.6.2 Effluent Data Summary

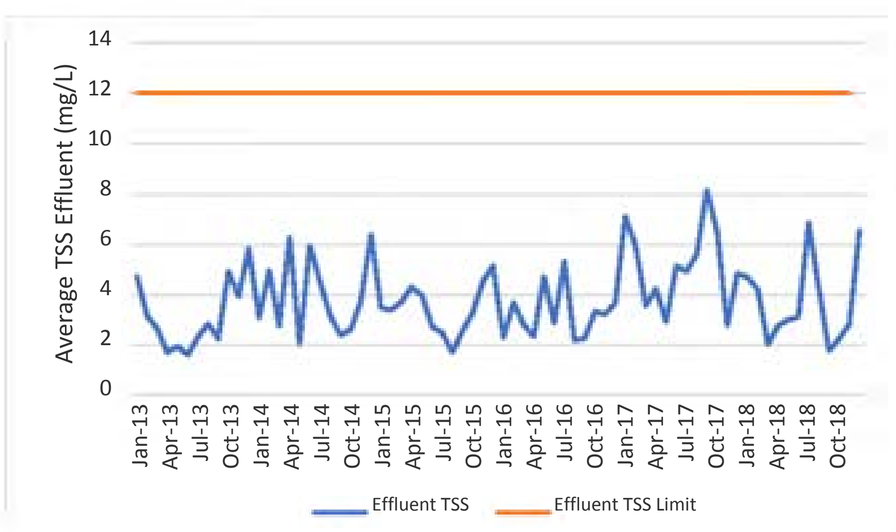
The facility has consistently (both historically and recently) performed very well. Figure 5-4 provides a graphical representation of the effluent quality from January 2013 through December 2018. The average effluent BOD_5 concentration during this time period was 2.37 mg/L, well below NPDES permit limits. The permit limit for monthly average is 10 mg/L and is represented by the orange line.

Figure 4: Effluent BOD Concentration



Similarly, the treatment facility's performance for total suspended solids removal has been very good. The monthly average effluent TSS concentrations range from 1.60 mg/L to 8.18 mg/L. The average effluent TSS concentration over January 2013 through December 2018 was 3.78 mg/L. Figure 5-5 provides graphical documentation of the treatment facility's effluent performance in comparison to the NPDES Permit Limits. The facility's performance has been relatively consistent.

Figure 5: Effluent TSS Concentration

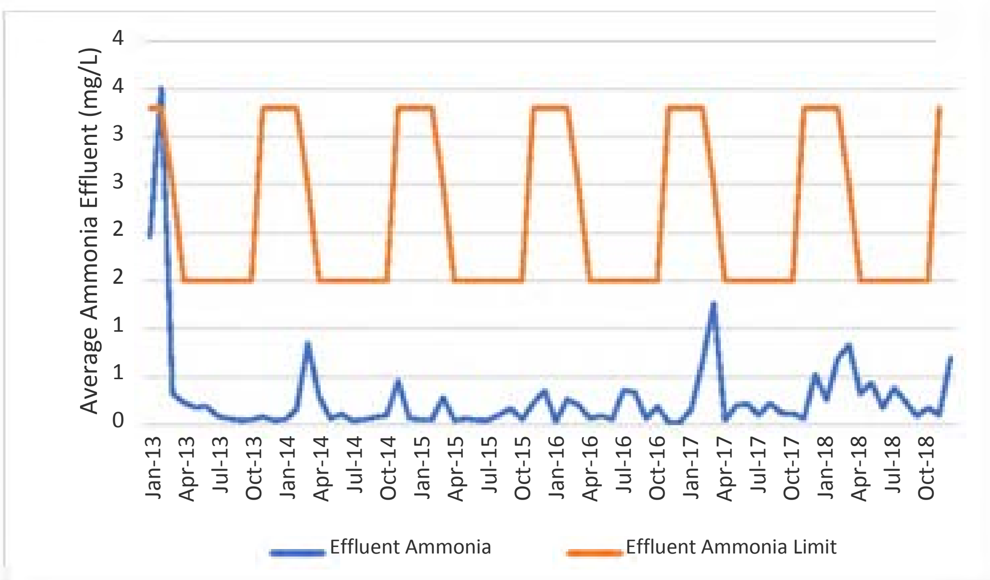


The Authority's NPDES Permit Limits for ammonia are as follows:

	Monthly Average	Weekly Average	Daily Maximum
April – October	1.5	None	3.0
November – February	3.3	None	7.5
March	2.5	6.3	12.4

Figure 5-6 provides a graphical representation of the Authority's effluent ammonia concentration from January 2013 through December 2018. The orange line represents the daily maximum concentration permissible under the NPDES permit while the light blue line represents the treatment facility's actual daily average effluent ammonia concentration. This facility has performed very well with regard to ammonia. The overall average effluent ammonia concentration from January 2013 through December 2018 was 0.28 mg/L. There has been one ammonia exceedance at the GAWTF in February 2013. The average ammonia flow was found to be 3.51 mg/L during a period with a monthly average limit of 3.3 mg/L. Since this exceedance, there have been no months where the ammonia concentration was within 50% of its relevant limit.

Figure 6: Effluent Ammonia Concentration (mg/L)



5.7 FUTURE EFFLUENT REQUIREMENTS

The Authority is required to monitor the plant effluent for phosphorus and nitrogen, among a number of additional parameters. However, the Authority is anticipating future regulations at the state or federal levels addressing total phosphorus (TP) and total nitrogen (TN) effluent concentrations and loads to be reduced. The current permit has a 1.0 mg/L TP limit to be achievable in 10 years of the effective date of the permit.

A Phosphorus Discharge Optimization Plan (PDOP) and a Phosphorus Removal Feasibility Study (PRFS) were completed by Baxter & Woodman in 2017. The PDOP evaluates various influent reduction measures, as well as effluent reduction measures by means of process optimization in order to reduce the phosphorus being discharged to the DuPage River and thereby the Mississippi River and ultimately, the Gulf of Mexico. The PRFS evaluates and recommends various capital improvement options that would allow the Authority to meet phosphorus limits of 1 mg/L, 0.5 mg/L, and 0.1 mg/L. The results of these evaluations, as well as a discussion on their viability is included within Section 7 of this report. Displayed below are the influent Total Phosphorus levels to the main treatment plant between 2012 and 2015 as found by the Glenbard Wastewater Authority.

Year	Average Influent Total Phosphorus (mg/L)
2012	4.85
2013	4.48
2014	5.27
2015	6.79
2016	6.69
2017	6.47
2018	5.07

5.8 NPDES Permit Exceedances

The Glenbard Wastewater Authority has witnessed four instances in the previous two years that have led to exceedances or violations of the NPDES permit.

On February 15th, 2017, a plant bypass with an estimated volume of 200,000 gallons occurred at the GWA Main WWTP. Wastewater was discharged onto the ground and into a storm sewer, in violation of the Illinois Environmental Protection Act and Illinois Administrative Codes. The violation notice was accompanied by instructions to determine the cause of the unauthorized plant bypass and investigate corrective actions to eliminate the possibility of any further raw sewage discharges.

On April 30th, 2017, the Glenbard Wastewater Authority Combined Sewer Overflow (CSO) Facility experienced heavy rainfall (2.44 inches) over a 15-hour period. Operators executed all prescribed procedures, including insuring that hypochlorite was feeding at the appropriate rate. However, fecal coliform concentrations of 756 fecal coliforms/100 mL were reported, in excess of the permit limit of 400 fecal coliforms/100 mL. At the measured effluent flow rate of 58.0 MGD, it was determined that there was not sufficient reaction time to achieve a total kill of coliforms. In response, the Authority has investigated purchasing a higher concentration hypochlorite solution that could be used during high flow events to function with a lower detention time.

On October 14th, 2017, the Authority received over 8.5 inches of rainfall within a 24-hour period, as well as 2.24 inches in the previous 24 hours. This high rainfall resulted in Too Numerous to Count coliform levels discharged from the CSO facility, triggering two consecutive coliform exceedances against the facility's NPDES permit. These exceedances occurred because the high effluent flow rate made for insufficient reaction time for sodium hypochlorite to kill coliforms in the effluent stream. It was determined that loading was too high for effective treatment to sufficiently reduce coliform levels. On the same dates at the main plant, high flows led to flooding in the filter building, where half of the filters were inactive as part of the disc filtration renovation project. This flooded water was then pumped to the plant discharge without undergoing tertiary filtration.

On August 31st, 2017, a representative of the Illinois EPA conducted an investigation at the GWA WWTP in response to previous odor complaints. The EPA representative ultimately detected offensive odors downwind of the facility and near the wastewater treatment plant. This exceedance occurred while the Authority was accepting a significant amount of high strength waste (HSW). The Authority ceased its HSW program temporarily following the odor violation. This program has since resumed under reduced daily loading.

On November 18, 2018, the Main WWTP lost one leg of the 3-phase power, causing control fuses for the raw influent pumps to fail. This resulted in overflowing of the influent wet well, with the overflow entering the DuPage River. It is estimated that 1,094,888 gallons overflowed from the system during the time that the influent pumps were offline. The associated pumping and electrical equipment is currently being replaced, reducing the likelihood of a similar exceedance occurring.

5.9 Unit Process Review

5.9.1 Raw Sewage Screening

The preliminary treatment facilities were built in 1977. The structure houses two Headworks Mahr bar screens that were last replaced in 2007, as well as a washer and conveyor system to process screenings.

IEPA Regulatory Requirements

Screening Devices are regulated under the provisions of Title 35: Subtitle C: Chapter II: Part 370.610 Illinois Recommended Standards for Sewage Works.

Mechanical Screens: Clear openings for mechanically cleaned screens may be as small as practical to assure the proper operation and maintenance of treatment facilities. Mechanical screens shall be located so as to be protected from freezing and to facilitate maintenance.

Design Data

Design Parameter:	
Number of Screens	2
Type	Bar
Spacing, mm	4
Screen width, feet	6
Firm Capacity (One out of service), MGD	47
Unit Capacity, MGD	47

Description

Raw sewage flows through two fine screens located in the Preliminary Treatment Building that operate in parallel. The screens collect rags, sticks, plastics and other non-biodegradable debris in the incoming wastewater. Debris and grit can interfere with treatment processes or create unnecessary mechanical wear and increased maintenance on downstream equipment. These screens were installed in 2007. The screens are equipped with a mechanical rake that collects debris from the screen surface. The debris is then discharged to a Hycor-Waterlink screw conveyer. Screenings are conveyed to a Lakeside washer/compactor, and then disposed of in a dumpster and transported to landfill.

Performance and Deficiencies

The bar screens were last replaced in 2007 and are in good condition. They are stainless steel Headworks Mahr bar screens with 4mm spacing. Each screen is capable of handling the full design flow through the system independently. The washer motor is currently rebuilt or replaced every two years. The screening facility is scheduled to undergo several updates in coming years; the influent gates and actuators are to be replaced, as is the level indicator at the influent well. HVAC systems in the building are currently being rehabilitated in the 2018 Facilities Improvement Project, which will assist with regulating temperatures and odor control in the facility.

Performance and Deficiencies

The bar screens are considered to be in good condition and were replaced 10 years ago. Additionally, regular maintenance of the washer is expected to extend its useful service life, and it is not anticipated to require major adjustments other than the current rebuild/replace schedule that the Authority operates. Proper washing and maintenance of the screen units will reduce stagnation of odor inducing solids. Operational practices at the screen building should include keeping doors and windows closed whenever possible. The screenings washer/compactor was refurbished in 2011 and is in still in functional operational condition, though it should be replaced in the next facility plan along with the conveyor. It is estimated that the replacement cost of the equipment should be budget for $200,000, and is identified within Section 9. Additionally, the corrosive environment within this facility could lead to a decreased lifespan for all system components, and rehabilitation of screening mechanisms and waste disposal facilities should be re-evaluated during the next facility planning period.

The Authority has received complaints regarding odor from residents living in close proximity to the plant. Agitation of flow as influent water passes through the screens may lead to the localized release of offensive hydrogen sulfide odors. These concerns will be amplified during periods of low rainfall, as the waste stream will not be diluted with infiltration and inflow. Odors at this facility are likely related to the hydrogen sulfide release from the influent raw sewage. The Authority is currently in the process of improving and upgrading the Bar Screen Building’s HVAC and air treatment system. This should serve to reduce odor releases from this process. Odor control will be discussed in greater depth in Section 6.

5.9.2 Raw Sewage Pumping

IEPA Regulatory Requirements

Raw Sewage Pump Stations are regulated under the provisions of Title 35: Subtitle C: Chapter II: Part 370.400 Illinois Recommended Standards for Sewage Works.

Multiple pumps or ejector units shall be provided Units shall have capacity such that, with any unit out of service, the remaining units will have capacity to handle the design peak flows.

Pumps handling raw sewage shall be capable of passing spheres of at least 3 inches in diameter. Pump suction and discharge openings shall be at least 4 inches in diameter.

Design Data

Influent Pump Station

Design Parameter:	
Number of Low Flow Pumps	2
Type	Submersible Screw Centrifugal
Unit Capacity, MGD	11.75 MGD
Number of High Flow Pumps	2
Type	Submersible Centrifugal
Unit Capacity, MGD	23.5
Firm Capacity (largest out of service), MGD	47.0

Description

After screening, raw sewage is pumped to the grit collection facilities. The raw sewage pumps are presently being renovated, with the addition of two low flow pumps and the replacement of the existing pumps with two high flow pumps. Originally, three pumps with a unit capacity of 22.5 MGD handled all influent raw sewage. The new pump layout includes a 16-inch discharge for the low flow pumps and a 30-inch discharge for the high flow pumps, and the two flow divisions are served by separate wet wells.

Performance and Deficiencies

The raw sewage pumping system is currently undergoing renovation, and will be in good operating condition throughout the planning horizon of this facility plan. Upsizing the system from three pumps of the same capacity to four pumps divided between high and low flow classifications should serve to improve the longevity of the raw sewage pumps by introducing improved redundancy and reducing run time for each pump. The new arrangement of pumps will provide a slightly larger firm capacity of 47.0 MGD (the plant's design capacity), up from the original firm capacity of 45.0 MGD.

5.9.3 Grit Removal

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.620 Illinois Recommended Standards for Sewage Works.

The inlet shall be located and arranged to prevent short circuiting to the outlet and oriented to the unit flow pattern so as to provide for adequate scouring segregation of organic and grit materials prior to discharge.

A detention time of at least 3 minutes at design peak flow should be provided.

Design Data

Design Parameter:	
Number of Units	2
Design	Vortex
Unit Capacity, MGD	23.5
Number of Grit Pumps	2
Grit Pump Unit Capacity, gpm	250

Description

Flow is conveyed from the raw sewage pump station to two Smith and Loveless Pista grit removal units and two Huber vortex grit washing units. These grit chambers achieve separation through constant rotation, water enters the chamber and is kept at a constant velocity. The rotational momentum pulls grit and sediment toward the center of the grit chamber where it is collected from the bottom of the tank, while water flows out of a side outlet. Adjustable paddles are used to control the rotational velocity and create a balance where heavier grit solids are removed from the center of the chamber while lighter organics remain suspended in the effluent for treatment via subsequent processes. Grit particles are then pumped for further washing and dewatering before disposal. Ecosorb is applied at this facility to cut down on offensive odors leaving the grit chambers. Odor control will be discussed further in Section 6

Performance and Deficiencies

The Smith and Loveless grit units were installed in 2005. The pumps in the basement of the grit removal building were also installed at this time. The grit equipment is in good condition and do not overflow as the old units tended to do, due to technological control improvements. The corrosive environment of grit pumping may lead to increased wear on these pumps over their lifespan. Although the existing pumps haven't had any issues, the pumps should be scheduled for replacement. The existing pumps have been exposed to a great deal of sand from the sand filters, and have not been recently pulled apart and rebuilt. The remaining equipment is in fair condition. All gates at this portion of the facility were also replaced in 2005 and are in good condition, with an estimated 10-15 years of service life before replacement. In addition the existing MCC and PLC within the Grit Building should be scheduled for replacement during future upgrades. The MCC and PLC's replacement schedule is identified in section 5.10.

Table 5-3: Preliminary Treatment Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Bar Screen Building					
Mechanical Bar Screen #1	Headworks	Good	2007	25	2032
Mechanical Bar Screen #2	Headworks	Good	2007	25	2032
Washer	Lakeside	Poor	2006	20	2026
Conveyor	Hycor	Poor	1998	20	2018
Raw Sewage Pump Station					
Raw Sewage Pump #1	Patterson	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #2	Patterson	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #3	Patterson	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #1	US Motor	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #2	US Motor	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #3	US Motor	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #1	Cutler-Hammer	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #2	Cutler-Hammer	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #3	Cutler-Hammer	Currently Being Replaced	2018	25	2043
Wet Well Drain Pump	Gorman Rupp	Currently Being Replaced	2018	25	2043
Grit Building					
Vortex Grit Washer #1	Huber	Good	2005	20	2025
Vortex Grit Washer #2	Huber	Good	2005	20	2025
Aeration Blower #1	Lamson	Fair	2009	20	2029
Aeration Blower #2	Lamson	Fair	2009	20	2029
Mag Meter - Raw Flows - 36"	ABB	Fair	2011	20	2031
Grit Pump #1	Morris	Good	2005	15	2020
Grit Pump #2	Morris	Good	2005	15	2020
Grit Removal Unit #1	Smith & Loveless	Fair	2005	20	2025
Grit Removal Unit #2	Smith & Loveless	Fair	2005	20	2025
Grit Blower Flow Meter	-	-	2005	20	2025
Grit Blower Flow Meter	-	-	2005	20	2025

5.9.4 Primary Clarifiers

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.710 Illinois Recommended Standards for Sewage Works. Primary Clarifier Rehabilitation

The hydraulic design of settling tanks shall be based on the anticipated peak hourly flow. If activated sludge is wasted to the primary settling unit, then the design surface settling rate shall not exceed 1,000 gallons per day per square foot based on design peak hourly flow, including all flows to the unit. Refer to subsection (b)(3) and Section 370.710.

Weir loadings shall not exceed 20,000 gallons per day per lineal foot based on design peak hourly flows for plants having design average flows of 1.0 MGD or less. Overflow rates shall not exceed 30,000 gallons per day per lineal foot based on design peak hourly flow for plants having design average flow of greater than 1.0 MGD. Higher weir overflow rates may be allowed for bypass settling tanks. If pumping is required, weir loadings should be related to pump delivery rates to avoid short circuiting. Refer to Section 370.410(c)(8).

Design Data

Design Parameter:	
Number	2
Diameter, ft.	110
Side Water Depth, ft	10
Unit Surface Area, sqft	9,503
Total Surface Area, sqft	19,007
Total Weir Length, ft	691
Total Volume, ft^3	190,066
Overflow Rate, @ 16.0 MGD, gpd/sf	843
Weir Loading, @ 16.0 MGD, gpd/ft	23,179
Detention Time, hr	2.13

Description

Primary treatment at the GAWTF includes two circular primary sedimentation tanks which perform solids and organic removal prior to biological treatment. Effluent from these clarifiers is combined with RAS from the intermediate clarifiers and split between the carbonaceous stage of the secondary treatment process. Flow over 18 MGD from the primary clarifiers is diverted directly to the second (nitrogenous) stage of the aeration process. Primary sludge is pumped from the bottom of the clarifiers to the gravity sludge thickener. Scum is skimmed from the top of the primary clarifiers and is discharged via scum pots to a Lakeside wedge wire scum screen before being disposed of in the landfill. Atomization of Ecosorb is utilized at the primary clarifiers to control odors, which will be further discussed in Section 6.

Loading Data

	Design
Primary Influent BOD_5, lbs./day	27,256
Primary Influent TSS, lbs./day	32,066
Removal Efficiency – BOD_5, %	35
Removal Efficiency - SS, %	57
BOD Removed, lbs/day	9,540
Suspended Solids Removed, lbs/day	18,277
Primary Effluent BOD_5, lbs/day	17,716
Primary Effluent TSS, lbs/day	13,788
Percent Solids (Primary Sludge), %	3.5 - 4.5
Sludge Volume, gpd	54,787
VSS Solids to Digestion (82%), lbs	14,987

Primary Sludge Pumps Design Criteria	
Number	2
Type	Progressing Cavity
Capacity per Pump, gpm	300 at 125 feet TDH

Performance and Deficiencies

The primary clarifier drive units were most recently replaced in 2004, while the clarifier mechanisms themselves are original to the construction of the plant and over 40 years old. The overflow and loading rates are within IEPA design standards, and have exhibited good BOD and TSS removal efficiencies. The primary clarifiers are in good overall condition, though during drought conditions they reduce organic levels excessively, leading the Food to Mass Ratio to drop in the subsequent biological process. In order to alleviate this condition, one clarifier is often taken out of operation during low flow conditions. Mag meters at the scum pots were replaced in 2014 and are in good condition, while the scum pots themselves are in poor condition. These scum pots eject based upon volume and generally take 10-15 seconds after filling before ejecting, adding the possibility of overflow.

All gates at the primary diversion structure are original to construction of the plant. These gates are in fair condition but should be scheduled to be replaced within the planning horizon of this report. Authority staff indicated a favorable opinion regarding the valves at the influent to the aeration process, as closing off these valves presents an operational feature that allows for easier cleaning. The effluent diversion structure is constructed such that the clarifiers can be back-flowed with clarified effluent, providing a good shock cleaning. Following sludge collection, primary sludge is pumped to the gravity thickener via two progressing cavity pumps. The pumps are in fair condition and are expected to require replacement or rehabilitation within 10 years. In addition, the existing MCC and PLC should be scheduled for replacement during future upgrades. The MCC and PLC's replacement schedule is identified in section 5.10.

A capital replacement project has been developed for the primary clarifiers and primary sludge pumping equipment. The estimated construction cost is included in the table below, this include replacement of the existing equipment, as well as replacement of the electrical and control systems.

Primary Clarifier Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$269,180
SITE WORK	$30,500
PRIMARY CLARIFIERS	$638,000
PRIMARY SLUDGE PUMPING	$608,000
Construction Sub-Total	$1,545,680
Contingency @ 15%	$231,852
Engineering @ 15%	$266,630
PROBABLE PROJECT COST:	**$2,044,162**

Table 5-4: Primary Clarifier Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Primary Clarifiers					
Primary Clarifier #1 Collector	Eimco	Fair	1977	30	2007
Primary Clarifier #1 Drive	WesTec	Fair	1999	15	2014
Primary Clarifier #1 Motor	Eimco	Fair	1977	15	1992
Primary Clarifier #2 Collector	Eimco	Fair	1977	30	2007
Primary Clarifier #2 Drive	WesTec	Fair	2004	15	2019
Primary Clarifier #2 Motor	Eimco	Fair	1977	15	1992

5.9.5 First Stage Biological Process (Carbonaceous)

IEPA Regulatory Requirements

The Treatment Facility utilizes a dual stage process for nitrification and BOD_5 removal, where the first stage is high-purity carbonaceous oxygen aeration basins and the second stage features nitrification aeration basins. As this process is not widely utilized in the state of Illinois, there is not a directly applicable IEPA Regulatory Outline. However, the table below outlines the Process Organic Loading guidelines as found in the JCAR Title 35: Subtitle C: Chapter II: Section 370.920 d) of the Illinois Recommended Standards for Sewage Works.

Process Mode	Plant Design Average Flow	Organic Loading (Lbs BOD_5/day/1000 ft^3)
Conventional complete mix, Contact stabilization, step aeration, tapered aeration	<1 MGD	35
	>1 MGD	50
Extended Aeration, Single Stage Nitrification	All	15

Description

The activated sludge deck at the Wastewater Treatment Facility uses two aeration basins that reduce carbonaceous biochemical oxygen demand (CBOD). The influent to this deck is a mixture of primary clarifier effluent and Return Activated Sludge (RAS) from the intermediate clarifiers. Flows up to 18 MGD flow to these basins, while flows in excess of 18 MGD are diverted directly to the second stage nitrification basins. Historically, the HPO system utilized pure oxygen produced in an on-site cryogenic facility that stripped oxygen from air for usage in the system. For the past several years, the Authority has begun hauling in liquid oxygen, following a cost-effective analysis comparing the rehabilitation of the cryogenic plant to third-party purchase of oxygen.

Design Parameter:	
Number	2
Tank 1 Width, ft	25
Tank 1 Length, ft	120
Tank 1 SWD, ft	14.9
Tank 1 Volume, gal	334,580
Tank 2 Width, ft	20
Tank 2 Length, ft	120
Tank 2 SWD, ft	14.9
Tank 2 Volume, gal	267,664
Total Volume, gal	602,245
Hydraulic Retention Time, hours	0.90

The aeration basins are sealed from the outside system under a concrete deck, preventing infiltration from low purity oxygen sources. The isolated HPO system is able to maintain higher dissolved oxygen (DO) levels than comparable systems that use air, as the partial pressure of oxygen is much higher. Since the system is closed from outside pressures, butterfly valves on the aeration piping can be adjusted to maintain oxygen levels when sludge flows increase. Aeration is encouraged through paddle mixing, where paddles splash liquid into the space above the liquid level. This aerates the tanks without the use of diffusers. Carbonaceous aeration basins have a depth of 14'-2".

Performance and Deficiencies

The entire biological process is original to the 1977 construction of the facility, and as such much of the equipment is either nearing or already past their intended service lives. While the facility consistently operates at a high efficiency, rehabilitation of the system would require a major capital investment. This puts the Authority at a crossroads – It will need to be determined whether the mixers, RAS and WAS pumps, and all support processes including the intermediate clarifiers and intermediate pump station, will be replaced or if conversion to an alternate biological process is preferred. This determination was the focus of the 2013 GWA Facility Plan which identified the need to rehabilitate the HPO and cryogenic systems. As part of this plan, four alternatives were evaluated; maintaining the two-stage HPO process, conversion to a single stage HPO process, constructing additional tankage and conversion to diffused air, and finally constructing additional tankage and conversion to IFAS.

Ultimately, the Plan recommended conversion to single stage nitrification while maintaining the HPO system. Single stage nitrification was then trialed at the GWA facility but was deemed unsuccessful. During this test, carbonic acids were not reduced, excessive foam was produced, and pH dropped below acceptable levels. As such, conversion to a single stage process while maintaining the HPO system has been eliminated as a viable alternative. Subsequently, the Authority commissioned several Feasibility Studies and technical memorandums evaluating long-term alternatives for the biological process, specifically within the context of NPDES permit limits for phosphorus, and future TN limits as well. This is reviewed in further detail within Section 7 of this report.

Table 5-5: Biological Process Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Biological Process					
UNOX Mixer (Motor, Gearbox, Impeller) HP #1	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #2	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #3	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #4	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #5	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #6	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #7	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #8	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #9	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #10	Union Carbide	Fair	1977	25	2002

UNOX Mixer (Motor, Gearbox, Impeller) HP #11	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #12	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #13	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #14	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #15	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #16	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #17	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #18	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #19	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #20	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #21	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #22	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #23	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #24	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #25	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #26	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #27	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #28	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #29	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #1	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #2	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #3	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #4	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #5	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #6	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #7	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #8	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #9	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #1	Union Carbide	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) HP #2	Union Carbide	Fair	1977	25	2002
Pure Ox Supply Valve & Operator - 6" #1	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #2	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #3	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #4	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #5	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #6	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #7	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #8	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #9	DeZurik	Fair/Poor	1977	20	1997

Pure Ox Supply Valve & Operator - 6" #10	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #1	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #2	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #3	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #4	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #5	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #6	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #7	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #8	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #9	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #10	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #1	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #2	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #3	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #4	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #5	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #6	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #7	DeZurik	Fair/Poor	1977	20	1997
Pure Ox Purge Blower #1	Siemens-Allis	Poor	1977	30	2007
Pure Ox Purge Blower #2	Siemens-Allis	Poor	1977	30	2007
Pure Ox Purge Blower #3	Siemens-Allis	Poor	1977	30	2007
Pure Ox Purge Blower #4	Siemens-Allis	Poor	1977	30	2007
Pure Ox Purge Blower #5	Siemens-Allis	Poor	1977	30	2007

5.9.6 Intermediate Clarifiers

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.710 Illinois Recommended Standards for Sewage Works.

Surface settling rates for intermediate settling tanks following series units of fixed film reactor processes should not exceed 1500 gallons per day per square foot based on design peak hourly flow. Surface settling rates for intermediate settling tanks following the activated sludge process shall not exceed 1000 gallons per day per square foot based on design peak hourly flow.

Design Data

Design Parameter:	
Number	2
Diameter, ft.	86
Side Water Depth, ft	12
Unit Surface Area, sqft	5,809
Total Surface Area, sqft	11,618
Total Weir Length, ft	1,080
Total Volume, ft^3	139,416
Overflow Rate, @ 16.0 MGD, gpd/sf	1,379
Weir Loading, @ 16.0 MGD, gpd/ft	29,647
Detention Time, hr	1.56

Description

Effluent from the first stage aeration basins flows into two intermediate clarifiers to the east of the aeration deck. These clarifiers have a diameter of 86-feet and have a side-water depth of 12 feet. The clarifier mechanisms and appurtenances were painted in 1999 and on drive was replaced. The second drive was replaced in 2007. The clarifier mechanisms, bridges, and wells are original – the north installed in 1969 and the south in 1977. The mechanisms are Walker Process plow-type and the drives are Westech with Sumitomo SM-Cylco reducers.

Performance and Deficiencies

The intermediate clarifier mechanisms, draft tubes, and walkways are well beyond their services lives and have been recommended for replacement or decommissioning through the past several Facility Plans. Similar to the biological process, this system will either require significant capital investment for rehabilitation, or alternative processes will be required. The 2013 Facility Plan which recommended conversion to single stage nitrification would result in the decommissioning of the intermediate clarifiers. The 2017 Feasibility Study and technical memorandums recommended conversion of the intermediate clarifiers to anaerobic basins for biological phosphorus removal. The fate of the biological process is further discussed in Section 7 of this report, however if two stage nitrification is to be maintained, the intermediate clarifiers will require rehabilitation with the 10-year CIP.

The effluent weir in the southern intermediate clarifier is not level, resulting in an asymmetrical distribution of flow over the weir. Water levels differ by approximately 2 inches across different sections of the clarifier. The metal structure is separating from the concrete and needs to be re-anchored. Additionally, the RAS T-valves adjacent to the intermediate clarifiers are in poor condition. These valves require frequent maintenance and seize regularly. As such, these valves should be scheduled for replacement.

Below is the estimated capital investment required to rehabilitate the existing intermediate clarifiers and t-valves.

Intermediate Clarifier Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$156,720
SITE WORK	$30,500
INTERMEDIATE CLARIFIERS	$750,500
Construction Sub-Total	$937,720
Contingency @ 15%	$140,658
Engineering @ 15%	$161,757
PROBABLE PROJECT COST:	**$1,240,135**

Table 5-6: Intermediate Clarifiers Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Intermediate Clarifiers					
Intermediate Clarifier #1 Collector	Walker	Fair	1969	30	1999
Intermediate Clarifier #1 Drive	Westec	Fair	2007	15	2022
Intermediate Clarifier #1 Motor	Walker	Fair	1969	15	1984
Intermediate Clarifier #2 Collector	Walker	Fair	1977	30	2007
Intermediate Clarifier #2 Drive	Westec	Fair	1999	15	2014
Intermediate Clarifier #2 Motor	Walker	Fair	1977	15	1992
Telescoping Valves (6)	-	Poor	1977/2003	15	1999
Parshall Metering Flume	-	Good/Fair	1955	50	2005

5.9.7 Intermediate Pumping Station

Description

The IPS receives effluent from the intermediate clarifiers, RAS from the final clarifiers, as well as flows over 18.0 MGD from the primary clarifiers. The mixed liquor once pumped, flows via gravity to nitro aeration trains. The Authority utilizes three 84-inch diameters pumps, each with a capacity of 12,500 gpm.

Design Data

Number of Pumps	3
Type	Archimedes Screw
Screw Diameter, inches	84”
Manufacturer	Lakeside
Unit Capacity	18.0 MGD
Firm Capacity, MGD (Largest out of service)	36.0 MGD
Motor Horsepower, hp	125
Motor Control	Auto

Table 5-7: Intermediate Pump Station Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation	Service Life	Replacement Year
Intermediate Pump Station					
Intermediate Screw Pump #1	Lakeside	Good	2014	30	2044
Intermediate Screw Pump #2	Lakeside	Fair/Poor	1977	30	2007
Intermediate Screw Pump #3	Lakeside	Fair/Poor	1977	30	2007
Pump #1 Lower Bearing	Lakeside	Good	2014	10	2024
Pump #2 Lower Bearing	Lakeside	Fair	2005	10	2015
Pump #3 Lower Bearing	Lakeside	Fair	2005	10	2015
Pump #1 Upper Bearing	Lakeside	Good	2014	10	2024
Pump #2 Upper Bearing	Lakeside	Good	2011	10	2021
Pump #3 Upper Bearing	Lakeside	Good	2011	10	2021

Performance and Deficiencies

Screw pumps are traditionally low maintenance, with the upper and lower bearings and gearboxes requiring the majority of rehabilitation attention. The augers can last 30-40 years with periodic re-flighting, patching, and re-coating. Pump #1 was replaced in 2014, while Pump #2 has been re-flighted and cleaned recently. Pump #3 is in poor condition. This pump station was previously scheduled for rehabilitation in 2012 including repair of Pump #3 and replacement of fiberglass covers. The influent gates were recently replaced with stainless steel and are in good condition. The existing MCC and PLC should be scheduled for replacement during future upgrades, and are identified in section 5.10. However, the 2013 Facility Plan recommended a conversion to single-stage nitrification and tabled this rehabilitation. Currently, the long-term needs of the pump station will depend on the future of the biological process.

The following estimate identifies the rehabilitation cost for the existing intermediate pumping station and includes the removal and replacement of screw pumps #2 and #3 in their entirety. Screw pump #1 itself would not be replaced since it was recently installed, however the project includes replacement of the bearings, gearbox, motor. All three screw pumps would be regrouted upon being reinstalled. In addition to the replacement of the pumping equipment, the intermediate pumping station would also have a complete replacement of the existing MCC's and PLC as the existing equipment had reached the end of its service life.

Although the future of the biological process has not been determined at this time, the existing station could be expanded as part of future improvements. Therefore the money invested into this facility, should not become a sunk cost for the Authority.

Intermediate Pumping Station Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$205,772
SITE WORK	$30,500
INTERMEDIATE PUMPING STATION	$1,167,600
Construction Sub-Total	$1,403,872
Contingency @ 15%	$210,581
Engineering @ 15%	$242,168
PROBABLE PROJECT COST:	**$1,856,621**

5.9.8 Second Stage Biological Process (Nitrification)

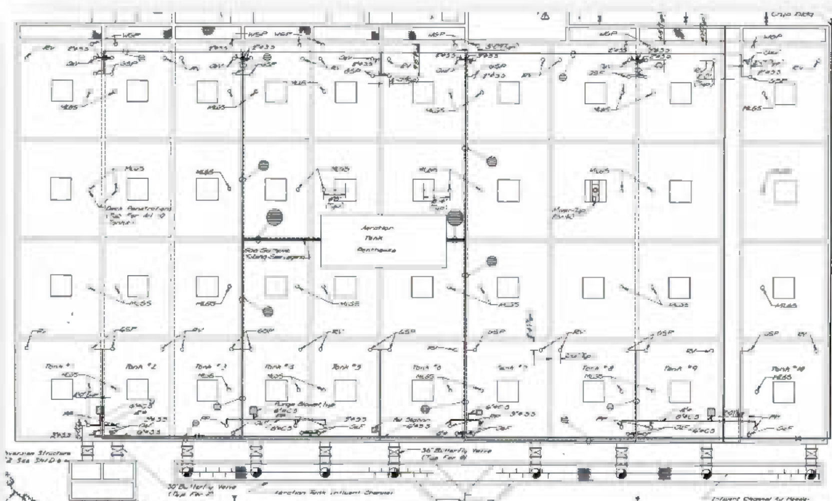
Design Data

Design Parameter:	
Number	8
Tanks 3,4,5 Width, ft	25.0
Tanks 3,4,5 Length, ft	120.0
Tanks 3,4,5 SWD, ft	14.9
Tanks 3,4,5 Volume, gal	334,580
Tanks 6,7,8,9,10 Width, ft	20.0
Tanks 6,7,8,9,10 Length, ft	120.0
Tanks 6,7,8,9,10 SWD, ft	14.9
Tanks 6,7,8,9,10 Volume, gal	267,664
Total Volume, gal	2,340,000
Hydraulic Retention Time, hours	3.5

Description

Following intermediate clarification and pumping, the Glenbard Wastewater Authority utilizes a second stage aeration phase for nitrification of ammonia. Autotrophic bacteria (Nitrosomonas and Nitrobacter) convert the ammonia to nitrite and ultimately nitrate in the presence of oxygen. The second-stage nitrification process was constructed common-wall with the first-stage biological process and mirrors much of the same layout; pure oxygen is also fed to this process along with paddle mixing to encourage aeration rather than diffusers. There are eight parallel nitrogenous aeration basins, three with volumes of 2768,000 gallons and five with volumes of 335,000 gallons, providing a total volume of 2.34 MG.

The condition of the second stage of the biological process is similar to the carbonaceous stage; the mixers, WAS pumps, and appurtenances will require a major rehabilitation in the near-term. This rehabilitation work has been tabled at this time until final selection of a future biological process is known. This is discussed further within Section 7, in the context of pending nutrient removal requirements.



5.9.9 Final Clarifiers

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.710 Illinois Recommended Standards for Sewage Works.

The hydraulic loadings shall not exceed 1,000 gallons per day per square foot based on design peak hourly flow, and 800 gallons per day per square foot based on peak hourly flow for separate activated sludge nitrification stage. Refer to Section 370.1210(c)(4).

The solids loading shall not exceed 50 pounds solids per day per square foot at the design peak hourly rate.

Weir loadings shall not exceed 20,000 gallons per day per lineal foot based on design peak hourly flows for plants having design average flows of 1.0 MGD or less. Overflow rates shall not exceed 30,000 gallons per day per lineal foot based on design peak hourly flow for plants having design average flow of greater than 1.0 MGD. Higher weir overflow rates may be allowed for bypass settling tanks. If pumping is required, weir loadings should be related to pump delivery rates to avoid short circuiting. Refer to Section 370.410(c)(8).

Design Data

Design Parameter:	
Number	4
Diameter, ft.	135
Side Water Depth, ft	14
Unit Surface Area, sqft	14,313
Total Surface Area, sqft	57,254
Total Weir Length, ft	1,696
Total Volume, ft^3	801,556
Overflow Rate, @ 16.0 MGD, gpd/sf	1,787
Weir Loading, @ 16.0 MGD, gpd/ft	24,521
Detention Time, hr	9.0

Description

Effluent from the aeration basins flows to the final clarifier diversion structure which relies on a hydraulic split to convey flow to each of the four clarifiers. Mixed liquor (MLSS) is discharged into each clarifier within the 19 ft diameter stilling wells at the center of the basin, which flocculates and settles downwards. From there, solids are settled to the bottom of the basin while clarified effluent flows over the effluent weirs and ultimately to tertiary filtration. Solids that settle out are collected via a rotating sludge rake and suction header system and are hydraulically conveyed to the RAS/WAS Sludge Pump Station.

Performance and Deficiencies

The final clarifiers are original (1977 construction), as well as the clarifier mechanisms. Each of the drives and motors were replaced between 1998-2002 and the mechanisms were repainted. While they remain in fair condition, the mechanism, motors and drives are beyond their service life. Another rehabilitation may extend the life of the clarifier components; however it may be more cost-effective to rehabilitate the clarifiers in full. These settling tanks are anticipated to remain in the process flow regardless of the future of the biological process, and as such would not represent a sunk cost.

The final clarifiers are equipped with new Fontaine gates at the splitter box, which have excellent performance. Covers were installed on the final clarifier troughs in 2017 and assist in reducing odor permeation. The southeast clarifier has bent metal along the skimmer arm after the arm was caught on the scum beach, though the draft tubes are undamaged. Scum beaches in all clarifiers need replacement and are in poor condition. Staff has indicated that being able to backflow into the clarifiers for cleaning similar to the primary clarifiers would be beneficial, however this would likely require raising the walls of the effluent splitter box. Lastly, Staff has noted the existing MCC and PLC should be scheduled for replacement. The MCC and PLC's replacement schedule is identified in section 5.10.

Recommendations

The estimated cost for the final clarifier rehabilitation is identified below. This rehabilitation includes a full rehabilitation of clarifiers, including replacement of the existing mechanisms, drives, gearboxes, and launder covers. In addition, the bottom of the existing launders would be blasted and coated with a protective coating such as a 100% solids polyurethane, such as SprayRoq Green 2. This would address the concerns of degradation of the concrete launders due to elevated pH levels in the biological process effluent. Lastly, the project includes a full rehabilitation of the WAS pump station.

Final Clarifier Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$472,136
SITE WORK	$30,500
FINAL CLARIFIERS	$2,354,630
SLUDGE PUMPING	$766,000
Construction Sub-Total	$3,623,266
Contingency @ 15%	$543,490
Engineering @ 15%	$625,013
PROBABLE PROJECT COST:	**$4,791,769**

Table 5-8: Final Clarifier Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Final Clarifiers					
Final Clarifier #1 Collector	Envirotech Eimco	Fair	1977	30	2007
Final Clarifier #1 Drive	Westec	Good	1999	15	2014
Final Clarifier #1 Motor	-	Fair	1999	15	2014
Final Clarifier #1 Launder Covers	Nefco	Good	2017	20	2037
Final Clarifier #2 Collector	Envirotech Eimco	Fair	1977	30	2007
Final Clarifier #2 Drive	Westec	Good	2001	15	2016
Final Clarifier #2 Motor	-	Fair	1999	15	2014
Final Clarifier #2 Launder Covers	Nefco	Good	2017	20	2037
Final Clarifier #3 Collector	Envirotech Eimco	Fair	1977	30	2007
Final Clarifier #3 Drive	Westec	Good	2002	15	2017
Final Clarifier #3 Motor	-	Fair	1999	15	2014
Final Clarifier #3 Launder Covers	Nefco	Good	2017	20	2037
Final Clarifier #4 Collector	Envirotech Eimco	Fair	1977	30	2007
Final Clarifier #4 Drive	Westec	Good	2002	15	2017
Final Clarifier #4 Motor	-	Fair	1999	15	2014
Final Clarifier #4 Launder Covers	Nefco	Good	2017	20	2037

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Sludge Pump Station					
Nitro WAS Pump #1	Shanley Pump	Fair	2004	20	2024
Nitro WAS Pump #2	Shanley Pump	Fair	2004	20	2024
Final Clarifier RAS Waste Pump VFD #1	-	Fair	2009	15	2024
Final Clarifier RAS Waste Pump VFD #2	-	Fair	2009	15	2024
Nitro Mag Meter - 4"	-	Replace	2003	20	2023
Carbo Mag Meter - 4"	-	Replace	2003	20	2023
Thickener Refresh Water Mag Meter - 3"	-	Replace	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #1	ABB Fischer & Porter	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #2	ABB Fischer & Porter	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #3	ABB Fischer & Porter	Fair	2010	20	2030
Final Clarifier RAS Mag Meter - 10 " #4	ABB Fischer & Porter	Fair	2010	20	2030
Thickened Sludge Pump	Moyno	Good	2010	15	2025
Thickened Sludge Pump	Moyno	Good	2010	15	2025
RAS Control Valve - 18" #1	Limitorque MX	Good	1977	15	1992
RAS Control Valve - 18" #2	Limitorque MX	Good	1977	15	1992
RAS Control Valve - 18" #3	Limitorque MX	Good	1977	15	1992
RAS Control Valve - 18" #4	Limitorque MX	Good	1977	15	1992
Thickened Sludge Mag Meter - 4" #1	ABB Fischer & Porter	Fair	2010	20	2030
Thickened Sludge Mag Meter - 4" #2	ABB Fischer & Porter	Fair	2003	20	2023

5.9.10 Tertiary Filters

IEPA Regulatory Requirements

Following are excerpts from Title 35: Subtitle C: Chapter II: Part and 370.1120 from the Illinois Recommended Standards for Sewage Works.

The peak hourly flow rate applied to the filter shall not exceed 5 gpm/sq.ft. of filter area, computed with one unit out of service.

Design Data

Number of Units	6
Installed Discs per Unit	25
Disc Diameter, ft	8.53
Surface Area per Disc, ft^2	57.1
Submerged Area per Unit, ft^2	1,329
Hydraulic Loading Rate, gpm/ft^2	4.91
Backwash Flowrate, gpm	240

Description

The Authority's tertiary treatment process utilizes disc filters in order to ensure compliance with its NPDES permit suspended solids concentration limits. Effluent from the final clarifiers flows via gravity to the disc filter building at the north end of the plant. Disc filters contain polyester elements that strain flow in an inside-out pattern. With this technology, influent wastewater is filtered by passing from the inside of two filter panels on a disk segment into the collection tank. Solids are contained on the inside of the disk filter while filtrate remains in the tank. Disc filter systems are contained in stainless steel tanks and are Kruger Hydrotech units. These filters remove suspended solids as small as 10 microns in size. Each filter currently has 25 discs installed but has capacity for up to 30 discs. Filter elements are partially submerged and are backwashed through counter-current spray. Typically, less than 1% of total flow is required for backwash. Hydrotech units have a much smaller footprint than typical media filters such as sand filters. Additionally, they are low maintenance with simple controls, but provide robust treatment capacities.

Performance and Deficiencies

Tertiary disc filters were installed in 2017/2018 and are in good working condition overall. When installed, the filters each contained 25 discs, although each of the six units has the capacity to hold up to 30 discs. This extra capacity allows the Authority some flexibility to expand the treatment ability of the existing filters easily in the future. Filters are cleaned using a mobile automated cleaning system. This cleaning system is mounted on a cart and can be attached to each of the six filters. Staff has noted that the existing PLC-L1 should be scheduled for replacement. The PLC replacement schedule is identified in section 5.10.

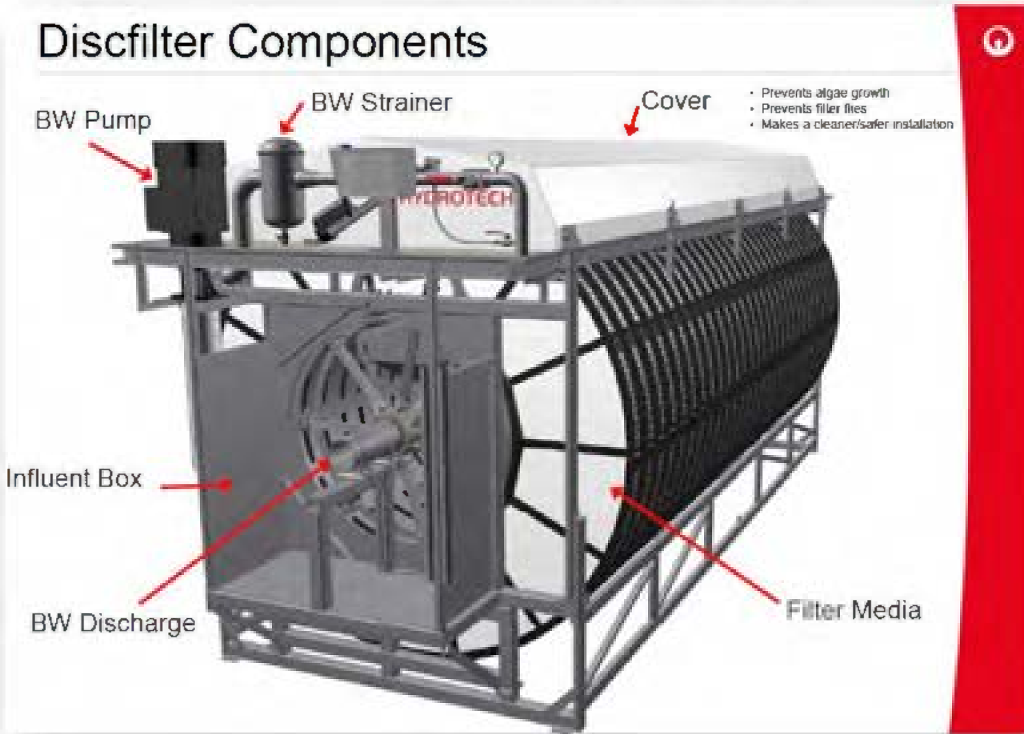


Figure 7: Disc filter Overview

Table 5-9: Tertiary Treatment Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Tertiary Treatment Building					
Disc Filter No. 1	Veolia/Kruger	Good	2017	20	2037
Disc Filter No. 2	Veolia/Kruger	Good	2017	20	2037
Disc Filter No. 3	Veolia/Kruger	Good	2017	20	2037
Disc Filter No. 4	Veolia/Kruger	Good	2017	20	2037
Disc Filter No. 5	Veolia/Kruger	Good	2017	20	2037
Disc Filter No. 6	Veolia/Kruger	Good	2017	20	2037

5.9.11 Effluent Disinfection

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part and 370.1020 and Illinois Recommended Standards for Sewage Works.

Because operating data and experience with this process is not well established, expected performance of the ultraviolet disinfection units shall be based upon either experience at similar full-scale installations or thoroughly documented prototype testing with the particular wastewater. Use of this process should be limited to high quality effluent having at least 65% ultraviolet radiation transmittance at 254 nanometers wave length and BOD and suspended solids concentrations no greater than 30 mg/l at any time. Projects will be evaluated by the Agency on the basis of the factors set out in Section 370.530(b).

Design Data

Number of Channels	4
UV Banks/Channel	2
UV Lamps/Bank	288
Total Number of Lamps	2,304
Capacity per Channel, MGD	14.3

Description

The final treatment process of the liquid stream is effluent disinfection. The Authority uses four parallel basins with ultraviolet lamp arrays manufactured by Fischer & Porter for disinfection prior to discharge to the East Branch of the DuPage River. Effluent from the tertiary filters flows to the disinfection building where it is treated to neutralize microorganisms, including viruses. Light in the ultraviolet range is capable of penetrating an organism's cell walls and disrupting the reproductive function of the organism's DNA. The spectrum emitted from a UV disinfection lamps contains an intense peak in the wavelength between 250 nm and 270 nm, the optimal range for the deactivation of bacteria. The GWA's current NPDES Permit allows for seasonal disinfection; therefore, the UV system is not operated year-round.

Performance and Deficiencies

Fischer & Porter, the manufacturer of the UV arrays, no longer produces UV units or the elements currently utilized. Although this would usually make repairs or replacements of UV system components costly and challenging, GWA has stockpiled replacement parts that will extend the effective longevity of the current UV system. These additional parts will provide a layer of protection to cover any possible repairs needed over the next 20 years. It is not anticipated that the disinfection process will require any major capital investments in the 10-Year CIP. Staff has noted that the existing PLC-O1 should be scheduled for replacement. The PLC replacement schedule is identified in section 5.10.

Table 5-10: Disinfection Equipment Condition Assessment

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Disinfection Building					
UV Disinfection Unit #1	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #2	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #3	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #4	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #5	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #6	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #7	Fischer & Porter	Good	2017*	20	2037
UV Disinfection Unit #8	Fischer & Porter	Good	2017*	20	2037
Non-Pot Pump #1	Grundfos	Good	2010	20	2030
Non-Pot Pump #2	Grundfos	Good	2010	20	2030
Non-Pot Pump #3	Grundfos	Good	2010	20	2030
Final Effluent Flow Meter	-	Fair	2006	20	2026

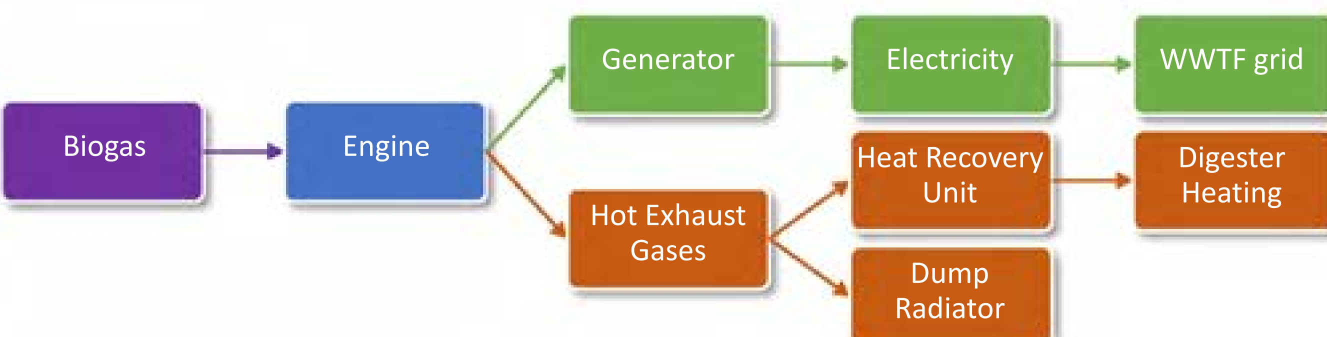
**Rehabilitation Year (Installed 1997)*

5.9.12 Combined Heat and Power System

As part of the anaerobic digestion process volatile (organic) solids are converted into water, carbon dioxide, and methane gas. Methane that is produced is typically utilized by treatment facilities in onsite boiler heat exchangers to help heat the digester to a temperature of around 95°F. Excess biogas is often wasted/burned off with a flare when not demanded for heat production. In an effort utilize this energy source, a combined heat and power (CHP) system can be installed to burn the excess biogas in a gas fired engine to produce both heat and electricity for use within the existing treatment facility. Energy can be used for different pieces of equipment, while the heat produced from the engine can be recirculated around the digester to help maintain the appropriate temperature. The following is a brief explanation on the process.

After biogas is produced in anaerobic digesters, it must be conditioned before it can be sent to CHP/cogeneration unit. This is to maximize energy efficiency of gas and preserve the mechanics of the cogeneration unit. Biogas typically has high levels of hydrogen sulfide and siloxane, as well as water vapor. These components are destructive to the cogeneration engine and if not removed can result in damage to the unit and significantly shortened service lives.

Once the gas is conditioned, it is combusted within an engine typically designed with duel feed trains capable of using digester gas as well as natural gas to maximize their energy output. In addition, the generators are jacketed to recapture heat and provide auxiliary hot water supply/return connections to assist in digester heating. The electricity generated is typically connected to the WWTP internal grid and used to reduce the demand for electricity from the local power utility, therefore reducing energy costs.



Design Data/Description

Prior to the CHP project, the Authority had two sources of power, one from the local utility, and a second from natural gas generators. The standby generators were onsite to provide power during times of emergency when local utility power is lost. In addition, all excess biogas was wasted/burned off with a flare when not demanded for heat production.

In 2016, the Authority installed a combined heat and power (CHP) system which allows for onsite power generation from burning excess biogas in generators rather than burning it off via the flare. The generators can also be supplemented with natural gas if needed. The Authority's CHP system was designed to produce 750 kW of electricity and 2.88 MMBTU/h of usable heat (equivalent to 842 kW), utilizing the biogas generated at the wastewater facility. The CHP system consists of two 375kW CHP units. The CHP unit is both an engine driven generator with a heat exchanger system.

Combustion of biogas in the engine runs the generator to produce electricity, which is then fed back to the WWTP for powering the existing electrical grid. As part of the combustion process, heat is generated, recaptured, and used to reheat the anaerobic digesters to optimal temperatures.

As part of this process additional biogas was required to effectively make the system operate. Therefore, the Authority developed a high strength waste (HSW) program to accept additional waste streams to be fed directly to the digester. The additional wastes included loads of fats, oil, and grease (FOG), as well as food waste. Directly feeding this source of waste to the digester is a way to increase the overall gas production if the influent loading does not support the required gas load.

Performance and Deficiencies

The system is in good operating condition and no CIP program is required to replace any of the components of the process. Currently the system is only operated on a part time basis, as the Authority has limited its loading of HSW to the digesters due to volatility and to optimize operational control. The existing FOG receiving station should be continually evaluated to identify ways to accept more diverse types of high strength waste. This would allow for a more diverse base of haulers and consistent feed to the digesters. The Authority is currently evaluating the construction of a lean-to structure which would contain the area and help mitigate odors, as well as keep the area clean. It is also recommended that the two fog receiving stations be reviewed hydraulically. This review would help identify if pumping into or between the existing tanks is feasible. This would allow the Authority to store some of the FOG and feed the digesters at a more consistent rate.

5.9.13 Sludge Stabilization and Disposal

IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part 370.820 and Part 370.840 from the Illinois Recommended Standards for Sewage Works.

Sludge thickeners to reduce the volume of sludge should be considered. The design of thickeners (gravity tank, gravity belt, dissolved-air flotation, centrifuge, and others) should take into account the type and *concentration of sludge, the sludge stabilization processes, storage requirements, the method of ultimate sludge disposal, chemical needs, and the cost of operation*

For digestion systems providing for intimate and effective mixing of the digester contents, the system may be loaded up to 80 pounds of volatile solids per 1000 cubic feet of volume per day in the active digestion units.

Design Data

Anaerobic Digestion

Number	3
Design	Circular
Diameter, ft. – Digester No. 1	80
SWD, ft. – Digester No. 1	23.5
Volume, gal – Digester No. 1	883,541
Diameter, ft. – Digester No. 2	60
SWD, ft. – Digester No. 2	23.5
Volume, gal – Digester No. 2	496,992
Diameter, ft. – Digester No. 3	60
SWD, ft. – Digester No. 3	18.5
Volume, gal – Digester No. 3	391,249
Total Primary Volume, gal	1,380,533
Covers, Digester No. 1, 2, and 3	Floating

Sludge Dewatering – Belt Filter Presses

Number	2
Size, m	2.2
Maximum Solid Loadings per Unit (Manuf. Specs), lbs per hour	1,500
Feed Pumps	2
Feed Pump Type	Progressing Cavity

Description

The Section 503 regulations of the Environmental Protection Act require sludge collected at wastewater treatment facilities to be stabilized prior to disposal on land. Stabilization is a process which deactivates or reduces the volatile solids within the sludge. The Authority complies with these requirements through use of an anaerobic digestion process. The anaerobic digestion system is a biological process that converts the volatile solids into liquid and gas.

The digestion process is time and temperature dependent - the longer the detention time the greater the volatile solids destruction. In order to optimize the process, the Authority thickens sludge prior to sending it to the digestion process. Decant from the gravity thickener flows over the weirs and is conveyed to the Glen Ellyn sanitary sewer, and ultimately back to the head of the plant. After thickening, thickened WAS (TWAS) is pumped from the Pump and Meter Building via progressive cavity pumps to the anaerobic digesters for solids stabilization. Activated sludge is wasted on a continuous basis. The Authority's gravity sludge thickener accepts primary sludge as well as waste activated sludge from the intermediate and final clarifiers. The gravity thickener has a metal geodesic dome designed to contain odors. The co-thickening of WAS and primary sludge results in a lower than ideal thickness of sludge entering the digesters, and increased the potential for odors. The gravity sludge thickener has a diameter of 55 feet and a side water depth of 10 feet.

Thickened sludge from the gravity thickener is pumped to two primary anaerobic digesters. These anaerobic digesters have floating covers. The larger primary digester has a diameter of 80 feet and a volume of approximately 884,000 gallons, while the smaller primary digester has a diameter of 60 feet and a volume of approximately 497,000 gallons. Both primary digesters have side water depths of 23.5 feet. Digested sludge from the primary digesters is then transferred to a secondary anaerobic digester with a 60-foot diameter and a volume of 390,000 gallons. This serves as a sludge storage tank before sludge is dewatered by belt filter presses and disposed for land application. Digested and dewatered sludge meets Class B requirements for land application.

The anaerobic digestion process uses four steps to properly digest the sludge; hydrolysis, acidogenesis, acetogenesis, and methanogenesis. Hydrolysis is the conversion of lipids and proteins to simpler building blocks such as fatty acids and amino acids. Acidogenesis, or fermentation, involves facultative and anaerobic bacteria known as acid-forming bacteria converting the simple monomers into volatile fatty acids which are then converted to organic acids such as acetate. In the methanogenesis step, anaerobic bacteria known as methane-forming bacteria convert the acids to methane gas and carbon dioxide. The overall rate of the process is generally limited by the activity of the methane-forming bacteria. These bacteria are sensitive to temperature, so the digester must be kept in either the mesophilic (80-110 ^{o}F) or the thermophilic (113-149 ^{o}F) range. The optimum sludge temperature within a mesophilic anaerobic digester is 95 ^{o}F. Involved bacteria are also sensitive to pH and sludge composition, both of which should be monitored along with VFAs (Volatile Fatty Acids).

This process uses anaerobic bacteria to break down complex proteins and sugars within the sludge to water, carbon dioxide, and methane. This produces a biogas byproduct and stabilized sludge. Methane is the main constituent in the biogas. In order for the anaerobic digestion process to occur, the digesters must be maintained at a temperature of around 95°F. Methane is then used by boilers to provide supplemental heat and maintain the optimum temperature. Excess biogas is burned off with a flare when not demanded for heat production. The Authority has recently installed a new combined heat and power (CHP) system which allows for onsite power generation from burning excess biogas in generators rather than burning it off via the flare.

Digested sludge is routed to the Sludge Dewatering Building which houses two Belt Filter Presses (BFPs). Polymer mixing units provide polymer to the digested sludge to encourage coagulation of sludge, improving dewatering efficiency. Shaftless screw conveyors are used to carry dewatered sludge from the BFPs to trucks for removal.

Performance and Deficiencies

The gravity thickener cover was assembled on site between 1990 and 1995. The inclusion of primary sludge in the gravity thickener influent increases the strength of sludge, also increasing the odors from the process. Houses along the southern edge of the facility are located closest to the gravity thickener and have registered many complaints of offensive odors. Alternatives for reduction of odors at this location are discussed within Section 6 of this report. In addition, Staff has also noted that the existing PLC-P and PLC-U should be scheduled for replacement. The PLC replacement schedule is identified in section 5.10.

The existing digester structure contains a garage door between the two primary digesters. This door may be located too close to the digesters according to NFPA 820 standards, which require 10 feet of wall adjacent to the digesters to be explosion proof. As this is an existing condition, the wall should only need to be altered in coordination with other future projects.

The cover of the secondary digester may be too heavy, resulting in gas not floating the roof. Additionally, PRVs have reportedly fail to sufficiently hold in gas. Liquid in the tank is currently what raises the level of the cover, at which point the level of the tank has already risen too high. Raising corbels or extending digester skirts will allow for higher digester levels while also improving gas collection processes to serve the new CHP facilities. In addition, by adjusting the corbels the Authority may be able to increase the overall runtime of the dewatering process. Due to the current configuration of the digester cover skirts and corbel elevation, over pressing of solids could result in the loss of the seal on the digester covers. Future upgrades to the sludge dewatering building may include a conversion to a direct polymer feed as opposed to the existing day-tank layout. This system has a large footprint and uses space inefficiently.

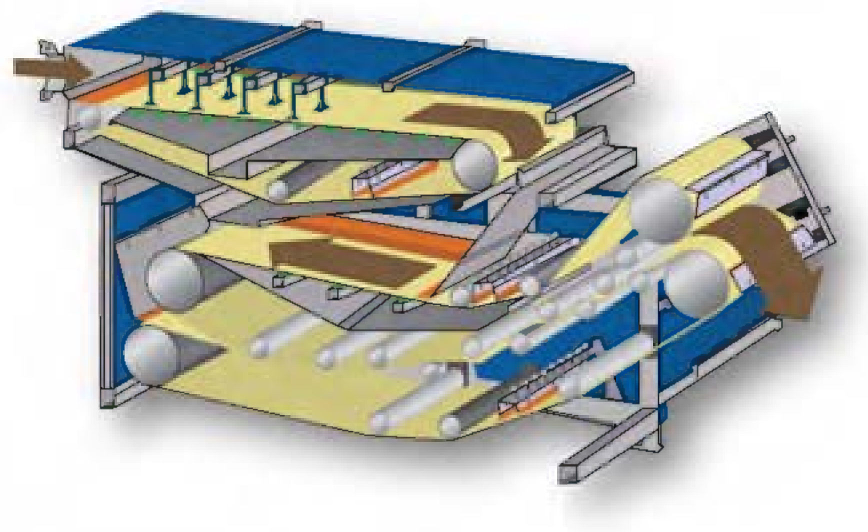
An alternative to extending the skirts of the digesters, would be to convert the existing backwash storage tank into a digested sludge storage tank. Through the conversion, the Authority would gain additional solids storage. This would increase the duration of time between dewatering periods, as well as allowing for longer runtimes during dewatering. The new digested sludge storage tank would include a full cover, hatches, and mixing system. The project also includes the addition of 6-inch digested sludge piping and transfer pumps to move solids from the digesters to the new storage tank. In addition, minor piping would need to be added from the storage tank to the belt filter press feed pumps. The estimated cost of the project is shown below.

Digested Sludge Storage	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$187,120
SITE WORK	$46,250
DIGESTED SLUDGE STORAGE TANK MODIFICATIONS	$854,748
Construction Sub-Total	$1,088,118
Contingency @ 15%	$163,218
Engineering @ 15%	$187,700
PROBABLE PROJECT COST:	**$1,439,036**

While the digestion complex was recently rehabilitated, the dewatering facilities are approaching, or in some instances exceeded, their anticipated service life. In addition to replacement of the dewatering and conveyor systems, the Authority should consider alternative dewatering technologies. Belt filter presses and centrifuges are the most prevalent dewatering equipment currently utilized in the municipal market, however rotary presses and screw presses have gained some popularity in wastewater applications. Screw presses has the largest footprint of the technologies and is usually installed in two-story structures. This is likely not an option if the Authority intends to utilize the existing Dewatering Building. Rotary presses are traditionally well suited for smaller facilities as they have a lower through-put per unit area. At the Authority's size, it is anticipated that replacement of the belt presses with similar units, or conversion to centrifuges would be the most cost-effective long-term solution for the plant's dewatering needs. These technologies as well as alternatives for upgrade are included below.

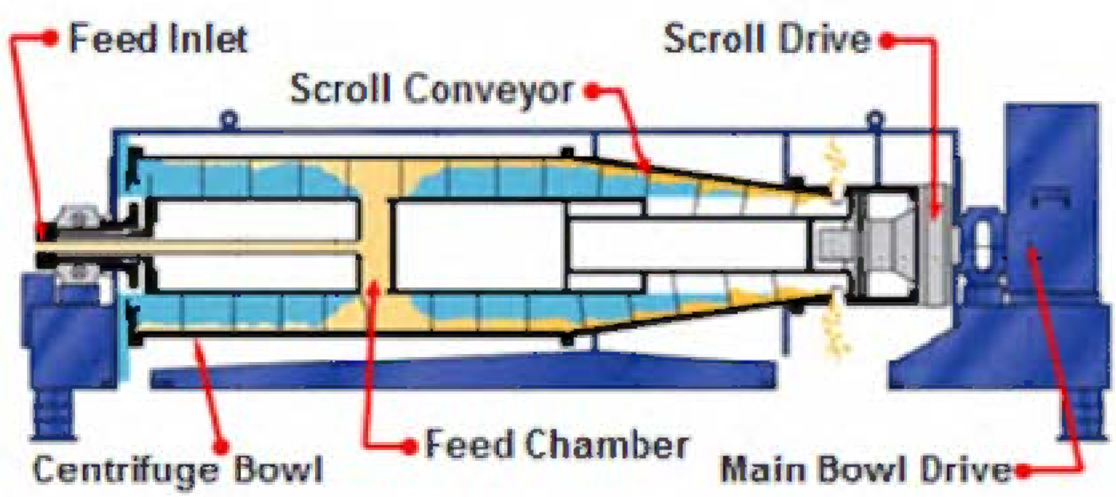
Belt Filter Press

Belt filter presses utilize parallel porous belts to apply compression and pressure in order to remove interstitial water from sludge. A chemical polymer is first added to sludge to encourage flocculation. Flocculated sludge then passes through a preliminary gravity dewatering section before entering the pressure zone rollers. Sludge is conveyed between tensioned belts through a series of rollers with decreasing diameter to squeeze out excess water. Typical final solids concentrations range from 18 to 25%.

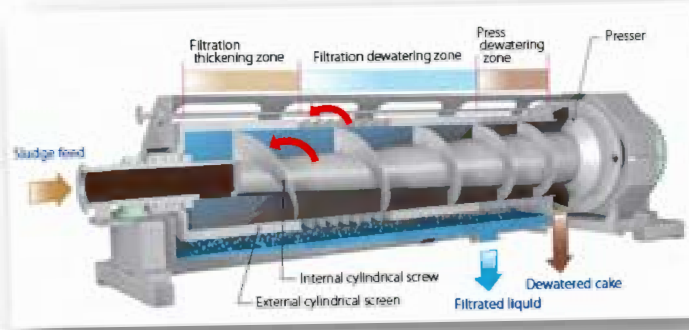


Centrifuge

Centrifugal dewatering utilizes rapid rotation of a cylindrical drum to induce separation of liquid and solid components of feed sludge. A chemical feed is used to flocculate sludge particles, increasing their diameter. More dense solids flow to the exterior of the rotating chamber as separated liquid flows in the opposite direction toward a liquid discharge. A screw conveyor within the centrifuge pushes sludge along the walls of the chamber to a solids discharge. Rotations within the centrifuge typically impart a force between 500 to 3,000 times the force of gravity on the feed sludge. Centrifugation is capable of yielding cake solids concentrations of 20 to 30%.

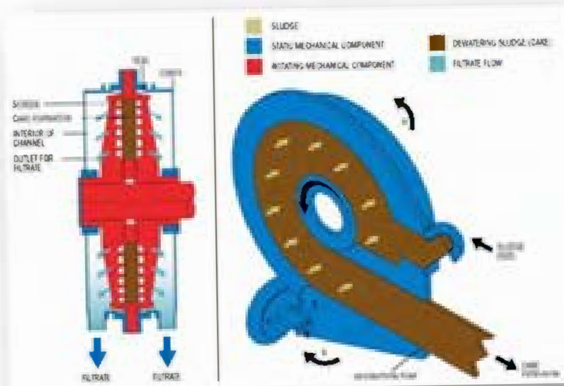


Screw Press



Screw presses use a slow rotating (below 1.5 rpm) auger to convey sludge through a series of fixed and moving rings, generating dewatering via gravity and shear forces. The moving shearing rings also help to clean the auger shaft, minimizing required maintenance. The auger increases in diameter along the length of the shaft, increasing pressure in the chamber. At the end of the contact chamber, an adjustable pressure cone is fitted to allow for final compression of solids. Solids concentrations of 15 to 20% are typically achieved through this process.

Rotary Press



The Rotary Press utilizes two parallel revolving screens to strain excess water from feed sludge. As with the alternatives discussed above, a polymer should be fed to increase flocculation of sludge particles. The rotary press uses a slow feed rate to increase frictional forces, inducing back pressure on the sludge that results in dewatering. Presses can be installed in skids, allowing the system to be scaled to the needs of the municipality. Cake solids concentrations from the rotary press are comparable to those derived from a screw press, with finished solids concentrations in the range of 15-20%.

Drying Beds

Drying beds utilize sand and gravel filter media to strain water from sludge via gravity, collecting leachate in drain outlets. Upon application to the drying bed, free water in the sludge percolates through the filtration media. Additional dewatering occurs as water entrapped in the sludge is evaporated slowly over the course of several days. Sludge is typically applied in a layer 8 to 12 inches thick over the drying bed. Drying beds may be covered to prevent rain infiltration. A decanting system is used to convey supernatant in the event that the filter media becomes clogged by sludge particles. Costs associated with drying bed dewatering are increased by the need for bed lining and groundwater quality monitoring. Cake solids concentrations of around 20% are typical for drying bed dewatering. Although stabilized, biosolids stored on exterior drying beds may induce odors. Therefore, these would not be recommended for the Authority due to the current emphasis on odor reduction throughout the facility.

Sludge Dryers

Sludge dryers utilize a heating media, such as oil, to heat metal paddles. The heat from the paddles is transferred to the sludge and water is evaporated. A dryer can produce Class A biosolids up to 92% solids, dramatically reducing the storage volume and disposal cost of sludge. For the sludge dryer to perform at this high level, it is recommended that the sludge fed to the dryer is pre-dewatered using a centrifuge or belt filter press. The dryer the feed sludge is, the better the sludge dryer will perform. Biogas produced and collected though anaerobic digestion could be utilized to power the sludge dryer as well as the condensation produced from heating the sludge. Depending on the biogas production, the Authority many need to utilize natural gas or other energy source to run this equipment. While dryers are considered as a method of reducing sludge storage needs following dewatering, they would not be considered for a direct dewatering application.

Sludge Dewatering Technology Comparison Matrix

Each of the described alternatives have specific advantages and disadvantages, a summary of which can be found in the table below. The three alternatives that merit further investigations include replacing the existing equipment in kind belt filter presses, or the installation of centrifuges or a screw press. Due to the potential for odors, drying beds are not recommended for further consideration. Additionally, due to the lower through-put of rotary presses, these are also not recommended for a facility such as the Authority with a 16 MGD design average flow.

Table 5-11: Sludge Dewatering Technology Comparison Matrix

	Advantages	Disadvantages
Belt Filter Press	- High cake solids concentration - Low energy demand - Low polymer demand	- Higher potential for odors - Medium footprint, though high height requirement - Frequent cleaning
Centrifuge	- High cake solids concentration - Small footprint - Enclosed process	- Large energy demand - Large polymer demand - Unit must be continuously operated
Screw Press	- Small footprint - Enclosed process	- Other alternatives yield higher cake solids - Low unit capacity
Rotary Press	- Small footprint - Relatively scalable - Enclosed Process	- Lower yield on cake solids - Low unit capacity
Drying Beds	- No energy demands - Low capital cost - Low polymer demand	- Large land requirement - Visibility to general public - Odor concerns
Sludge Dryer	- Class A Sludge - Green Technology - Biogas	- High Energy Costs - High Capital Cost - Potential for Odors - Requires upstream dewatering

5.9.14 Comparison of Alternatives – Dewatering Upgrades

The existing sludge handling facility houses a GBT, belt filter press, sludge pumps, polymer systems and conveyer. The existing sludge handling building was constructed as part of the 1977 original and therefore, the structure has a significant amount of service life remaining. The existing upstairs of the facility is large in size and should be able to incorporate the different technologies that are being evaluated.

Three alternatives have been developed for rehabilitation/upgrade of the dewatering facilities. A new building was not considered as part of the analysis due to the high capital costs which are significantly more than utilizing the existing structure. The first alternative is the most cost-effective solution and includes replacing the equipment in kind. The second alternative includes replacing the equipment with centrifuges. The third alternative includes the installation of a screw press and demolition of the existing belt filter presses.

Alternative #1 – Belt Filter Press (Replace in Kind)

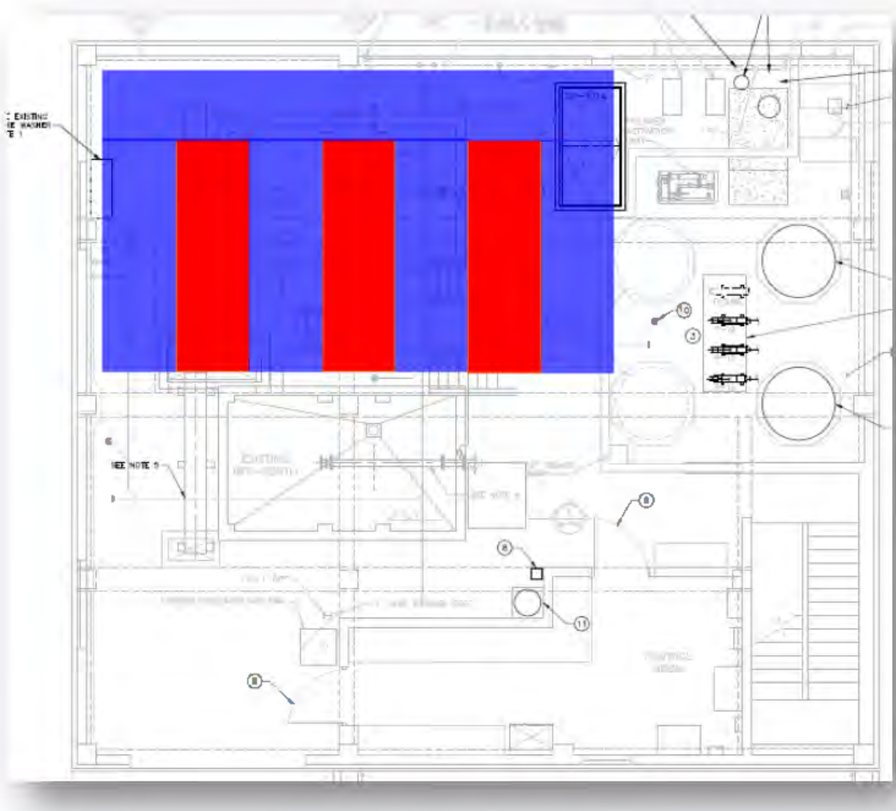
This alternative includes rehabilitation of the dewatering components within the existing building to leverage the remaining service life of the physical building. The Dewatering Building was originally constructed in 1977, retrofitted in 1991 to upgrade the original belt filter presses.

The conceptual layout includes two new belt filter presses rated at 200-250 gpm to allow for dewatering only five hours per day, five days per week. The conveyors will be properly sized to convey dewatered sludge from both belt filter presses running simultaneously. The conveyor system will include multiple drop points to allow for discharge across the receiving trailer. A crane system will be included within the project.

Sludge Dewatering Rehabilitation - Belt Filter Press		
Description		Total Probable Cost
	SUMMARY	
GENERAL CONDITIONS		$248,460
SITE WORK		$51,500
DEWATERING BUILDING		$1,256,500
	Construction Sub-Total	$1,556,460
	Contingency @ 15%	$233,469
	Engineering @ 15%	$268,489
	PROBABLE PROJECT COST:	**$2,058,418**

Alternative #2 – Centrifuges

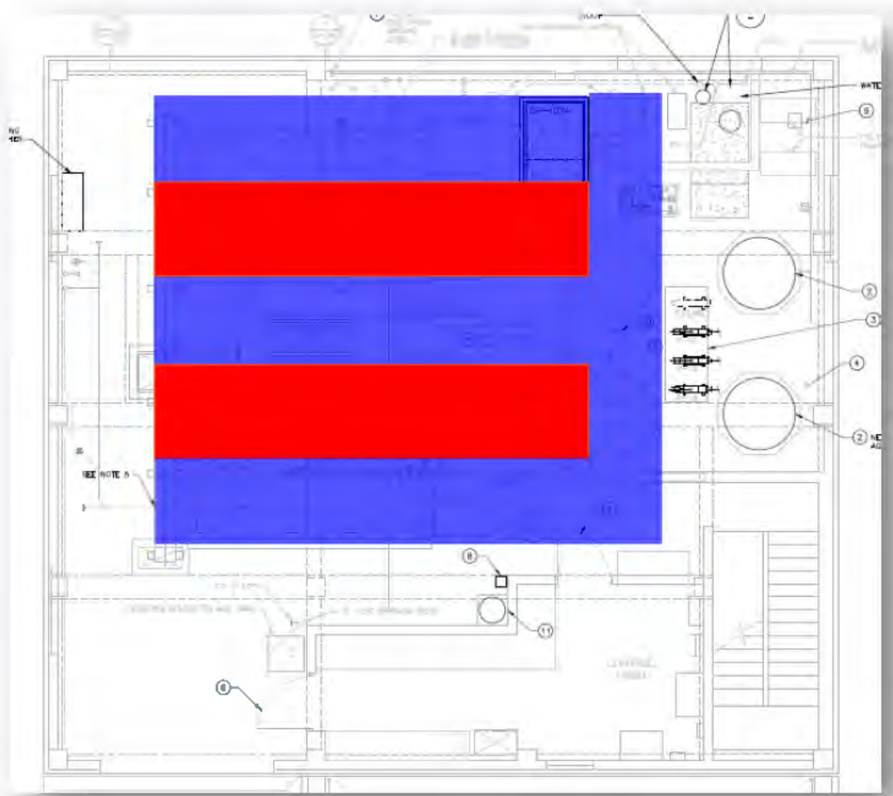
The conceptual layout includes three new centrifuges rated at 200-250 gpm to allow for dewatering only five hours per day, five days per week. The conveyors will be properly sized to convey dewatered sludge from both centrifuges running simultaneously. The small centrifuges will need to be reoriented north-south, to allow for easier maintenance. A crane system will be included within the project to allow for the removal and replacement of bowls and scrolls as needed, which is typical maintenance of centrifuges every 5-7 years.



Sludge Dewatering Rehabilitation - Centrifuges		
Description		Total Probable Cost
	SUMMARY	
GENERAL CONDITIONS		$400,664
SITE WORK		$51,500
DEWATERING BUILDING		$1,908,200
	Construction Sub-Total	$2,360,364
	Contingency @ 15%	$354,055
	Engineering @ 15%	$407,163
	PROBABLE PROJECT COST:	**$3,121,581**

Alternative #3 – Screw Press

The final alternative includes the replacement of the existing two belt filter presses with two sludge screw presses. The conceptual layout and design of the screw press includes the installation of a primary screw press with a redundant backup for periods of maintenance and emergency. Cake will be conveyed to the truck dock with new conveyors that will be properly sized to convey dewatered sludge from both presses running simultaneously. A crane system will be included within the project to pull screw press elements.



Sludge Dewatering Rehabilitation - Screw Press	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$538,660
SITE WORK	$51,500
DEWATERING BUILDING	$2,791,500
Construction Sub-Total	$3,381,660
Contingency @ 15%	$507,249
Engineering @ 15%	$583,336
PROBABLE PROJECT COST:	**$4,472,245**

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Anaerobic Digesters					
Anaerobic Digester Cover #1	Walker Process	Good	2010	25	2035
Anaerobic Digester Cover #2	Walker Process	Good	2010	25	2035
Anaerobic Digester Cover #3	Walker Process	Good	2010	25	2035
Waste Gas Burner	Varec Biogas	Good	2010	25	2035
Anaerobic Digester Boiler #1	US Filter	Good	2010	25	2035
Anaerobic Digester Boiler #2	US Filter	Good	2010	25	2035
Anaerobic Digester Mixing Pump #1	Vaughan	Good	2010	20	2030
Anaerobic Digester Mixing Pump #2	Vaughan	Good	2010	20	2030
Anaerobic Digester Mixing Pump #3	Vaughan	Good	2010	20	2030
Anaerobic Digester Mixing Pump #4	Vaughan	Good	2010	20	2030
Sludge Circulation Pump #1	Moyno	Good	2010	20	2030
Sludge Circulation Pump #2	Moyno	Good	2010	20	2030
Sludge Circulation Pump #3	Moyno	Good	2010	20	2030
Sludge Grinder #1	JWC	Good	2010	20	2030
Sludge Grinder #2	JWC	Good	2010	20	2030
Sludge Grinder #3	JWC	Good	2010	20	2030
Sludge Grinder #4	JWC	Good	2010	20	2030
Sludge Grinder #5	JWC	Good	2010	20	2030
Belt Filter Press Feed Pump #1	Moyno	Good	2010	20	2030
Belt Filter Press Feed Pump #2	Moyno	Good	2010	20	2030
Digester Transfer Pump #1	Wemco-Hidrostal	Good	2010	20	2030
Digester Transfer Pump #2	Wemco-Hidrostal	Good	2010	20	2030

Performance and Deficiencies

One of the matrixes for evaluating the different sludge dewatering technologies considers the depreciation of the equipment due to the atmospheric conditions of the building. Due to the open nature of a belt filter press, it inherently creates a more corrosive environment than other dewatering equipment such as centrifuges.

The existing dewatering building has approximately $300,000 with of depreciable equipment within the dewatering area. Looking at the overall service life of the equipment, as well as in that type of environment, the total loss due to the environment is approximately $5,000 per year. Looking at the overall depreciation over the life of the equipment, it is loss of around $100,000. The overall additional capital investment of the centrifuge equipment is $1.1 Million. Therefore, it is not cost effective to invest the additional capital of $1.0 Million for the centrifuge technology. It is recommended that the Authority budget for future sludge dewatering equipment to be belt filter presses.

During the conceptual design of the future dewatering improvements it is recommended that the Authority consider replacing the existing belt filter presses with 2.5M belts versus 2.0M. This could help reduce the overall time required to dewater solids and runtime of the equipment per week. The overall increase in capital cost between the two units is relatively minimal and could become cost effective based on O&M and labor costs.

Sludge Dewatering Rehabilitation - Belt Filter Press	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$255,900
SITE WORK	$51,500
DEWATERING BUILDING	$1,318,500
Construction Sub-Total	$1,625,900
Contingency @ 15%	$243,885
Engineering @ 15%	$280,468
PROBABLE PROJECT COST:	**$2,150,253**

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Primary Sludge & FOG Removal					
Primary Sludge Pump #1	Moyno	Fair	2007	15	2022
Primary Sludge Pump #2	Moyno	Fair	2007	15	2022
Primary Sludge Grinder #1	JWC	Fair	2007	15	2022
Primary Sludge Grinder #2	JWC	Fair	2007	15	2022
Scum Pump #1	Yeomans Pump	Fair	2007	15	2022
Scum Pump #2	Yeomans Pump	Fair	2007	15	2022
Air Compressor #1	Gardner Denver	Fair/Poor	2007	10	2017
Air Compressor #2	Gardner Denver	Fair/Poor	2007	10	2017
Primary Sludge Mag Meter - 10"	-	Poor	2010	20	2030
Primary Sludge Mag Meter - 10"	-	Poor	2010	20	2030
Carbo Mag Meter - 24"	ABB	Poor	2014	10	2024
Nitro Mag Meter - 24"	ABB	Poor	2014	10	2024
Primary Scum Concentrator/Compactor	Lakeside	Good	2010	20	2030
Scum Wash Water Pump	-	Good	2010	15	2025

Equipment	Manufacturer	Condition	Installation Year	Service Life	Replacement Year
Sludge Thickening/Dewatering					
Gravity Belt Thickener	Ashbrook	Not in Use	2003	20	2023
Polymer Mixing Unit #1	Norchem Industries	Good	2018	15	2033
Polymer Mixing Unit #2	Norchem Industries	Good	2018	15	2033
Belt Filter Press #1	Ashbrook-Simon-Hartley	Fair	1991	20	2011
Belt Filter Press #2	Ashbrook-Simon-Hartley	Fair	1991	20	2011
Polymer Transfer Pump #1	Moyno Pumps	Good	2003	15	2018
Polymer Transfer Pump #2	Moyno Pumps	Good	2003	15	2018
Polymer Transfer Pump #3	Moyno Pumps	Good	2003	15	2018
Polymer Day Tanks #1	Snyder Ind.	Good	2003	30	2033
Polymer Day Tanks #2	Snyder Ind.	Good	2003	30	2033
Gravity Sludge Thickener					
Gravity Sludge Thickener Cover	-	Fair	1977	30	2007
Gravity Thickener Collector	-	Fair	1977	30	2007
Gravity Sludge Thickener Drive	Westec	Fair	1999	15	2014
Gravity Sludge Thickener Motor	-	Fair	1977	15	1992

5.9.15 Abandoned Facilities (Cryogenic Oxygen Generation Plant)

The Authority was designed with an operating cryogenic oxygen plant onsite. The oxygen plant would produce high purity oxygen for the biological processes. Due to the high operating costs and equipment reaching the end of its expected service life, the cryogenic oxygen plant was shut down in the last several years. Currently the Authority has contacted with a liquid oxygen hauler to provide liquid oxygen for the biological process. Liquid oxygen is hauled onsite and stored within existing oxygen storage tanks.

Design Data

Cryogenic Oxygen Plant

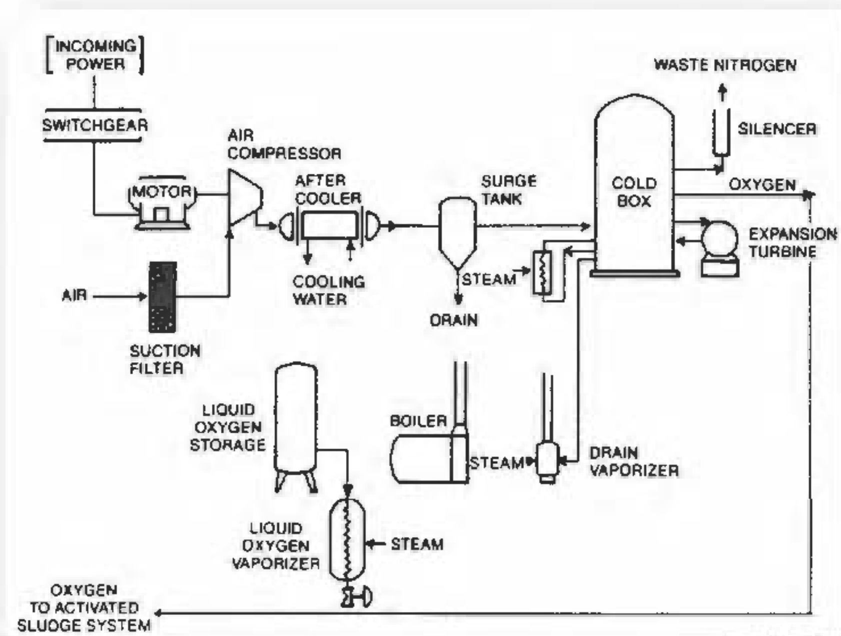
Maximum Capacity, tons/day	32
Minimum Capacity, tons/day	23
Compressor Motor hp	700

Description

The existing biological treatment process utilizes high purity oxygen as part of the BOD conversion/nitrification process. Due to the large demand of high purity oxygen, during the design and construction of the original treatment facility in 1977 a Cryogenic Oxygen Plant was also constructed.

The cryogenic oxygen plant takes filtered and cooled compressed air and conveys it to a cold box. At which time the compressed air is progressively cooled against outgoing oxygen that has been produced, as well as waste nitrogen gases. As part of this cooling process, moisture and CO_2 impurities are removed from the air stream. The chilled air then passes through an adsorbent bed to removal the remaining impurities prior to entering a high-pressure distillation column. Vapors are condensed at the top of the column. Liquid that is produced within the high-pressure column is transferred to a low-pressure column for final distillation, and where both liquid and gas oxygen is removed from the system.

The produced oxygen is then transferred to liquid storage facilities. This liquid storage was developed to allow the treatment plant to have onsite oxygen for periods of emergency such as a power failure. During that emergency event, the cryogenic plant would be offline, and the stored liquid oxygen would be converted back to gas, and utilized for the biological process.

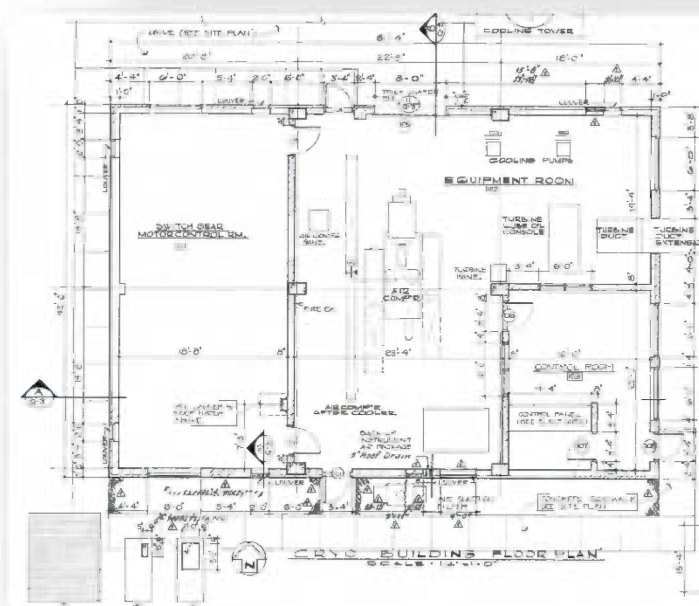


Performance and Deficiencies

The Authority was originally designed with an operating cryogenic oxygen plant onsite, which produces high purity oxygen. The system was originally installed during the 1977 treatment plant construction, and most of the equipment has reached the end of its service life.

In 2017, the Authority moved forward with shutting down the cryogenic oxygen plant and contracting with a local liquid oxygen hauler to supply the required oxygen for treatment. Airgas is the hauler that is currently under contract with the Authority to provide the oxygen in liquid form, where it is delivered and stored onsite. As the oxygen is required, the liquid is vaporized and conveyed to the treatment process.

The existing cryogenic oxygen plant was outlined to be decommissioned and demolished as part of the previously facility plans. Depending on the selected alternative for future nutrient removal, demolishing of the existing oxygen plant may be recommended. However, if pure oxygen is still going to be utilized as part of future processes, a study should be performed to identify if hauling in the liquid oxygen is more cost effective than generating it onsite. Demolishing and decommissioning the existing system and equipment should be budgeted at around $400,000.



5.10 Power and Control Systems

The following section provides an analysis of the existing site electrical equipment, summarizes past reports, and evaluates the remaining service life, condition, and replacement cost. As electrical equipment ages it not only becomes outdated but also loses efficiency and becomes prone to more frequent failures. The majority of the electrical equipment was installed when the GAWTF was placed into service in the late 1970's and is reaching the end of its useful service life.

The service life of Motor Control Centers (MCCs), Motor Starter Controllers (MSCs), and Programmable Logic Controllers (PLCs) varies significantly due to environmental conditions and operations. The corrosive atmospheres can wear internal circuitry and external components of equipment. Normal cycling of the system also attributes to the wearing of internal components. Along with general wear and tear the equipment may experience, newer models of equipment are designed, tested and supported by manufacturers each year, and eventually parts for specific models become so outdated that they can become more expensive than a new unit or are simply no longer available. An expected service life for these types of electrical equipment is typically 30 years. However, that can be extended by good maintenance practices as has been the case for the Authority.

5.10.1 Electrical Service, Backup and Redundancy

Power is supplied to the Authority via two sources; a West Side Distribution and an East Side Distribution. Each MCC has the capacity to be fed from either source, in the event that either go down. In addition, if/when there is a loss of power from both main sources, the Authority has a backup generator system with significant capacity to run critical loads to the site.

Three on-site 800 kW natural gas generators can produce ample power to run the facility in the event of service failure. Like the service lines, the backup generators supply MV underground to each Switchgear; building MCCs and MSCs specifically. However, the two sources run through the same duct banks, pull-boxes and manholes at times. Thus, a failure at a single location may cause failure of multiple circuits.

Most Control Equipment is fed from both sources for redundancy, usually using an Automatic Transfer System (ATS). The Pad Mounted Utility Transformers onsite are a combination of 3-wire and 4-wire units. The majority the plant is grounded with a 4-wire source and is supplied by 12,470v Medium Voltage and redundant source connections. During a power failure, power is automatically transferred to a new power source. However, operators have the option to put individual processes back online by hand, and selecting the source power to be used. Additionally, some processes consist of ungrounded 3-wire sources, that are powered through a single Utility Transformer that selects the source power automatically.

The medium voltage is distributed throughout the site and stepped down to 480v at each MCC. The exception to this is the Cryogenic building, which instead steps the power down to 4,160v to run Cryogenic loads. However, this system has been taken offline and is no longer in service as liquid oxygen is no longer produced onsite. The transformers supplying each building and the power available at each location is detailed in the Available Power Table (Table 5-12). It should be noted that certain switchgear does not have a Neutral reference due to previous design decisions.

Table 5-12: Motor Control Center Power Table

Available Power				
Building	MCC	Transformer Feed/Supply	MCC Wiring	Available Power For Loads
Bar Screens	MCC-AA, MCC-BB	T-8, Ungrounded T-9, Ungrounded	3ph, 3w	480v
Raw Sewage Pump Station	MCC-B	T-8, Ungrounded T-9, Ungrounded	3ph, 3w	480v
Grit Removal Building	MCC-C	T-1, Grounded T-2, Ungrounded	3ph, 4w	480v, 277v
Primary Scum	MCC-EA, MCC-EB	T-1, Grounded T-2, Ungrounded	3ph, 4w, 3ph, 3w	480v, 277v 480v
Aeration Building	MCC-FA, MCC-FB	T-1, Grounded T-2, Ungrounded	3ph, 4w	480v, 277v
Bio-Augmentation	MSC-GA, MSC-GB	T-1, Grounded T-2, Ungrounded	3ph, 4w	480v, 277v
Intermediate Pump Station	MCC-H	T-1, Grounded T-2, Ungrounded	3ph, 4w	480v, 277v
Sludge Pump and Metering Building	MCC-J	T-1, Grounded T-2, Ungrounded	3ph, 4w	480v, 277v
Filter Building	MCC-L	T-12, Grounded T-13, Grounded	3ph, 4w	480v
UV Building	MCC-O	T-12, Ungrounded T-13, Ungrounded	3ph, 4w	480v
Sludge Dewatering Building	MCC-PA, MCC-PB	T-10, Ungrounded T-11, Ungrounded	3ph, 3w	480v
Cryogenic Building	MCC-Q	T-4, Grounded T-5, Ungrounded	3ph, 4w	480v / 277v
Admin Building	MCC-R	T-6, Grounded	3ph, 4w	480v / 277v
Maintenance Building	MCC-S	T-6, Grounded	3ph, 4w	480v / 277v
Pump and Blower Building	MCC-T	T-4, Grounded T-5, Ungrounded	3ph, 4w	480v / 277v
Anaerobic Digesters Building	MCC-U	T-10, Ungrounded T-11, Ungrounded	3ph, 3w	480v
Co-Gen Building	MCC-V	T-8, Ungrounded T-9, Ungrounded	3ph, 3w	480v

5.10.2 Facility Electrical Upgrades

As stated previously, a large portion of the existing electrical equipment has reached the end of its useful life and should be scheduled for replacement. Over the last several years the Authority has been upgrading key equipment which has reached the end of its service life. During the design of those projects, a strategic effort has been made to incorporate electrical upgrades to maximize budgets and ensure equipment compatibility.

Figure 5-8 identifies both the location as well as the installation year for each of the pieces of electrical equipment onsite. In addition, Table 5-13 summarizes that information in tabular form and indicates the location of the equipment and years of installation. The table also details the scope of suggested equipment upgrades and provides an estimated cost for each of the upgrades. It is noted that these cost estimates are estimations of just the switchgear and panel upgrades, assuming wiring can be re-used.

Figure 5-8: Electrical Equipment Location

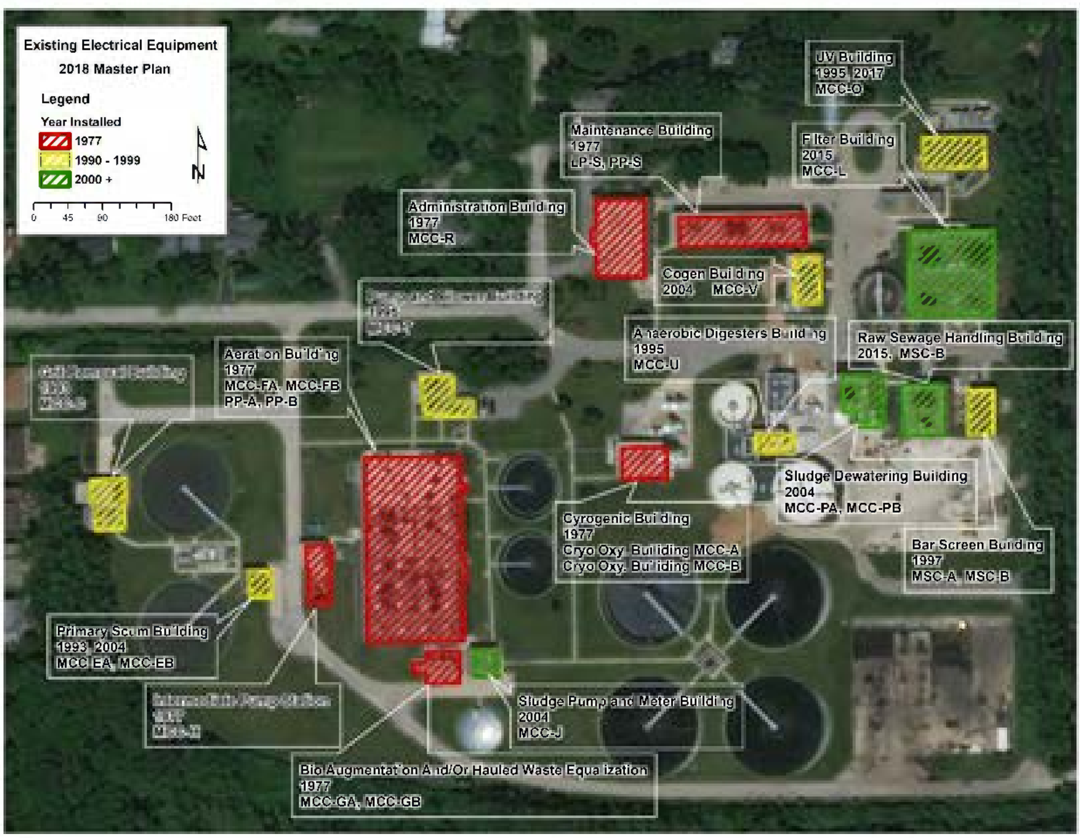
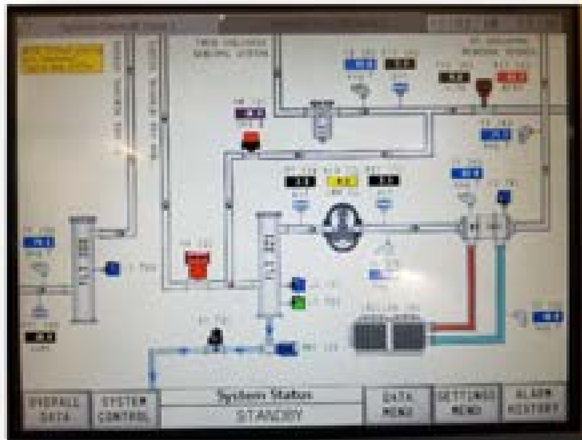


Table 5-13: MCC Equipment Service Life/Replacement Schedule

Equipment Evaluation - Power				
Building	**Equipment Tag**	**Installation Year**	**Suggested Equipment Upgrades**	**Estimated Cost**
A – Bar Screen Building	MSC-A MSC-B	1997 2015	Replace Exterior MSC-A. Replace Exterior MSC-B	$100,000
B - Raw Sewage Handling	MCC-B MSC-B	2015	- Replace Exterior MSC-B.	In Progress
C – Grit Removal Tanks and Blower Building	MCC-C	1993	Replace MCC-C	$200,000
E - Primary Scum Building	MSC-EA MSC-EB	1993 (2004) 2004	Replace MSC-EA. Replace MSC-EB.	$100,000
F - Aeration Building	MCC-FA PP-A MCC-FB PP-B	1977 (2004 Skeleton)	Replace MCC-FA Replace PP-A Replace MCC-FB Replace PP-B	$360,000
G – Bioaugmentation And/Or Hauled Wastes Equalization	MSC-GA MSC-GB	1977	Replace MSC-GA. Replace MSC-GB.	$80,000
H – Intermediate Pump Station	MCC-H	1977	Replace MCC-H.	$150,000
J – Sludge Pump and Meter Building	MCC-J	2004	-	-
L – Filter Building	MCC-L	2015	-	In Progress
O – UV Building	MCC-O	1995 (2004 Added Second Feed)	-	-
P – Sludge Dewatering Building	MCC-PA MCC-PB	2004	-	-
Q – Cryogenic Building	CRYO MCC-A CRYO MCC-B	1977	Replace CRYO MCC-A Replace CRYO MCC-B	$180,000
R – Admin Building	MCC-R	1977	Replace MCC-R	$100,000
S – Maintenance Building	LP-S PP-S	1977	Replace LP-S Replace PP-S	$40,000
T – Pump and Blower Building	MCC-T	1995	-	-
U – Anaerobic Digesters Building	MCC-U	1995	-	-
Co-Gen Building	MCC-V	1994	-	-
Tin Shed	MSC-Tin Shed LP-Tin Shed	1977	Replace Entire MSC-Tin Shed. Replace Entire LP-Tin Shed.	$80,000

Sufficient replacement funds should be established to support the rehabilitation and replacement efforts necessary to ensure continued operation of all equipment onsite, and to maintain safe electrical equipment. Based on the estimated replacement costs provided, it is recommended that the Authority budget to replace all of the identified equipment over the next ten years. This investment would equate to approximately $140,000/year. After each fiscal year, the overall investment should be reevaluated to ensure that sufficient funds are allocated for future improvements and MCC's replaced as part of CIP projects are removed from the schedule.

5.10.3 Control Systems



The Authority's control system has been constructed and rehabilitated over a number of years. While fairly robust, the system is in need of communication and infrastructure upgrades to maintain clear operation, tracking and archiving of available information. As stated previously, much of the equipment was originally installed during the initial construction of the treatment facility and has reached the end of its useful service life.

The existing PLC's that are located throughout the facility are Allen-Bradley-type SLC, and are no longer in production or supported from Allen-Bradley. Therefore, as time continues, replacement parts are becoming not only more expensive to obtain, but also harder to source. During site visits with GWA staff, it was identified that the upgrade of the existing PLC's is an immediate need to ensure operations continue without any controls issues. GWA staff identified that the preference for equipment moving forward would continue to be Allen Bradley as equipment and support has been exceptional.

Upgrading the internal hardware will provide benefits such as improved process efficiency; from the utilization of greater data management and more accurate control loops for process control, and Operators will have greater access to plant wide data; improving monitoring, evaluation and reaction time to unexpected events. It is recommended that the communication equipment be upgraded by removing the existing SLC-504 processors and replacing them with CompactLogix L33ER processors. These controllers will continue to be supported for a number of years and should provide adequate I/O for the Authority's future needs. In addition, devices and wiring upgrades for the communication of this equipment back to the Facility SCADA system will include replacing the existing DH+ Communication units and Phoenix Digital fiber switches with Ethernet Communications and Aruba Fiber switches.

Table 5-14 identifies the location and replacement recommendations for the control equipment. In general, the recommendations follow the following criteria, replacement of any equipment originally installed in the 1977 project, as well as focusing on equipment located in corrosive locations such as MSCs located on the exterior of the Grit Building, and finally internal hardware/software upgrades to improve user interface. Recently the Authority has been starting to perform PLC upgrades throughout the plan to Compact Logix. It is recommended that the Authority continue this effort throughout the remaining PLC's onsite.

Table 5-14: PLC Service Life/Replacement Schedule

Equipment Evaluation - Communications				
Building	Equipment Tag	Installation Year	Suggested Equipment Upgrades	Estimated Cost
A – Bar Screen Building	PLC-A	2004	Upgrade PLC: SLC 504 to CompactLogix L33ER. Replace DH+ comms and Phoenix Digital fiber witch with Ethernet comms and Aruba Fiber switch.	$70,000
	PLC-B2	2005		In Progress
	PLC-B3	2005		In Progress
B – Raw Sewage Handling	MSC-B	2015		In Progress
C – Grit Removal Tanks and Blower Building	PLC-C	2004		$50,000
	PLC-C1	2004		$50,000
E – Primary Scum Building	PLC-E	2004		$50,000
	PLC-E1	2004		$50,000
J – Sludge Pump and Meter Building	PLC-J	2004		$50,000
L – Filter Building	PLC-L	2015		In Progress
	PLC-L1	1997		$50,000
O – UV Building	PLC-O	2017		$50,000
	PLC-O1	1997		$70,000
P – Sludge Dewatering Building	PLC-P	2004		$80,000
Q – Cryo Building	PLC-Q	2004		$150,000
T – Pump and Blower Building	PLC-T	1995		$50,000
U – Anaerobic Digester Building	PLC-U	2010		$75,000
CSO Facility	PLC-LOM	2015		$100,000
Valley View Lift Station	-	2015		$35,000
St. Charles Lift Station	-	2015		$50,000
SRI Lift Station	-	1997		$30,000
Hill Avenue Lift Station	-	2015		$45,000
CSO Lagoon RTU	-	2015		$20,000
NRI Maryknoll RTU	-	2015		$20,000
Lombard NRI RTU	-	2015		$20,000
N-36 RTU	-	2015		$20,000
Wilson Avenue RTU	-	2015		$20,000
Central Lombard RTU	-	2015		$20,000
Northwest Glen Ellyn RTU	-	2015		$20,000

Sufficient replacement funds should be established to support the rehabilitation, repair, and replacement efforts necessary to ensure the continued future reliability of the aging instrumentation and control equipment, as well as to take advantage of new technology. Based on the estimated replacement costs provided, it is recommended that the Authority budget to replace all of the identified equipment over the next ten years. This investment would equate to approximately $100,000/year. In addition, it is recommended that as part of each capital improvements project that the Authority completes that the PLC's identified be incorporated into the scope of the project. The overall budgeted values should then be updated based on the improvements that have been completed at the end of each year.

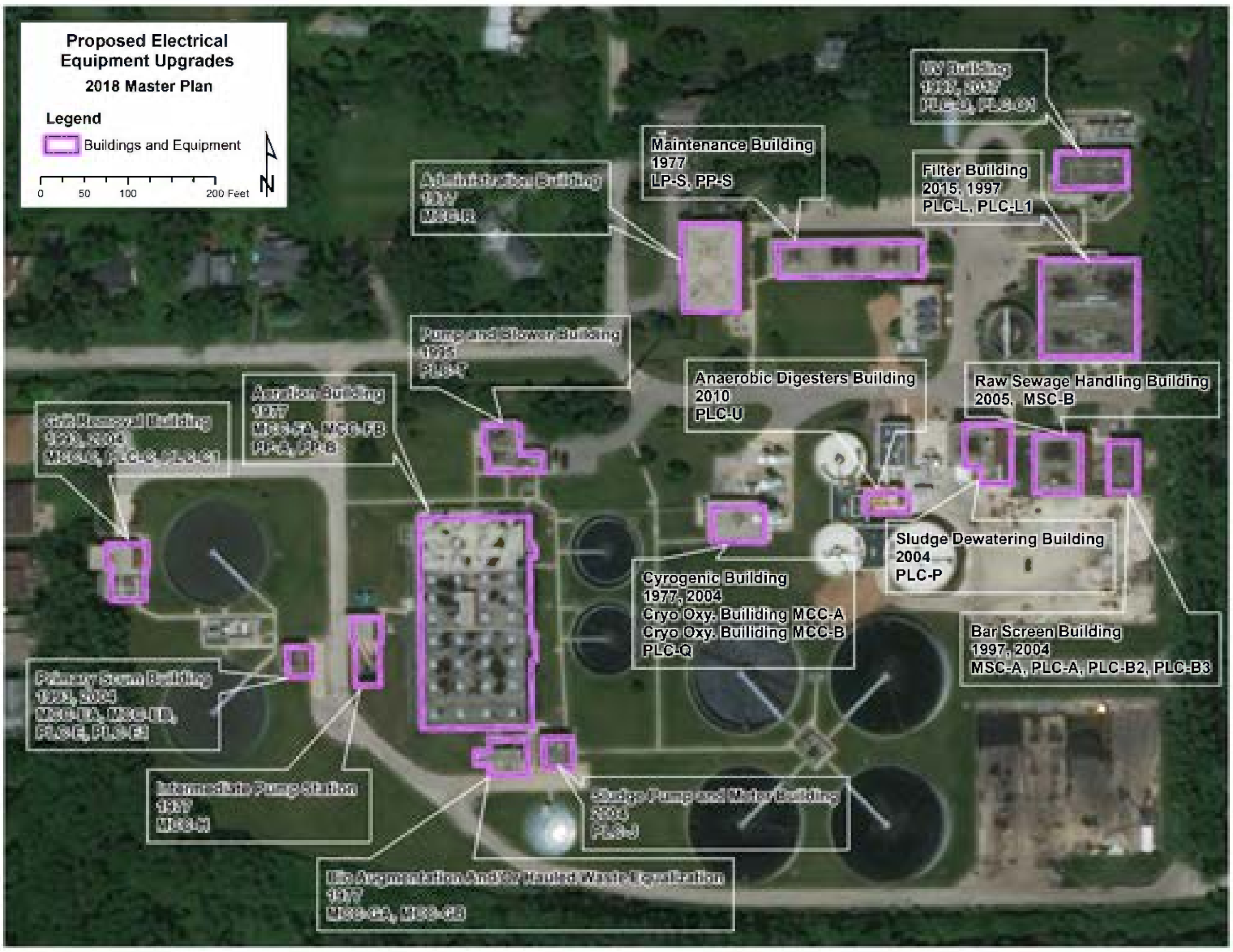


Figure 5-9: MCC & PLC Upgrade Locations

5.11 Electronic O&M Manuals

Within the wastewater treatment facility, it is critical to retain current operation and maintenance manuals. During the original construction of the Glenbard WWTP, the Authority was provided with approximately 12 binders outlining the operation and maintenance items for each piece of equipment onsite. Over the last 40 years, some of the equipment has been replaced, and the existing O&M manuals are no longer up to date. Therefore, it is recommended that the Authority develop a program or project to completely rebuild the existing O&M's. The new O&M's could be utilized as training tools for new staff members, as well as reference guides for equipment troubleshooting and repairs.

The project should include removal of all O&M's and documentation that is no longer relevant due to the replacement of equipment, as well as the incorporation of new equipment that has been reinstalled or added to the facility. The individual process sections should include written descriptions and information for processes, equipment, operations, controls, and maintenance. The final deliverable should be a document that is in an Adobe Portable Document Format (pdf) or some other equivalent format. The Authority should also have several of the copies of the final updated O&M as hard copies throughout the WWTP, installed on all computers, as well as all on field tablets/notebooks. Recently, there have been some advancements in electronic O&M's and depending on how the data is organized, they can also include some special features such as search functions, dynamic images mapping, video streaming, as well as links to manufactures websites and online support. A preliminary estimate of the fees associated with this type of project are estimated at $380,000. However, the final cost of services for preparing the electronic O&M manual will vary depending on the detail and scope desired.

5.12 Future Land Acquisition

The existing wastewater treatment facility is located on a large parcel (shown in red) that currently provides sufficient space for all of the treatment processes. However, due to the impeding regulatory requirements (as described in detail in Section 7), it may be necessary to acquire property in the future for additional treatment processes. Currently within the 10-Year CIP it is not anticipated that the Authority will need to purchase additional land.

Due to the fact that the existing facility is currently land locked by residential properties, the Authority may want to consider purchasing parcels directly adjacent to the facility when they become available throughout the next decade. In particular, the north side of the administration building, and the west side of the grit tanks should be considered. Parcels to the South are less desirable due to the number of parcels required to be purchased for substantial space for future needs.

SECTION 6
ODOR CONTROL

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6. Odor Control

The Authority received an increasing number of resident complaints regarding odors over the last several years, which has prompted the Authority to investigate potential sources of these odors and develop short and long-term control strategies.

6.1 Wastewater Odor Background

Revisions to the Clean Air Act in the 1990s required the EPA to develop and enforce rules and regulations for industries that emit toxic or offensive substances into the air. The act dictates that sensory perception of an "odor" has four major dimensions: detectability, intensity, character, and hedonic tone.

1. **Detectability:** The minimum concentration for detection in a certain percentage of the population.
2. **Intensity:** The perceived strength of the odor sensation.
3. **Character:** What the substance smells like.
4. **Hedonic Tone:** The relative pleasantness or unpleasantness of the odor.

The IEPA is the regulatory agency which governs air quality. The Joint Committee on Administration Rules (JCAR) is the rule-making body. According to JCAR, Title 35-B-I-1 a nuisance odor may be present when:
Section 245.121 Objectionable Odor Nuisance Determination

a) On or adjacent to residential, recreational, institutional, retail sales, hotel or educational premises when odor is detectable in the ambient air after it is diluted with eight volumes of odor-free air as measured by the Scentometer;
b) On or adjacent to industrial premises when odor is detectable in the ambient air after it is diluted with twenty-four volumes of odor-free air as measured by the Scentometer;
c) On or adjacent to premises other than those above when odor is detectable in the ambient air after it is diluted with sixteen volumes of odor-free air as measured by the Scentometer;
d) When concurrent determinations made by three trained inspectors as outlined above in any given one hour period and at intervals of not less than fifteen minutes result in two positive determinations in each series of three determinations; and
e) Provided that any quantitative odor level measurements taken to arrive at a determination that an objectionable odor nuisance exists shall be at or beyond the property line or at or near places where people live or work.

6.2 TYPICAL ODOR SOURCES IN WASTEWATER TREATMENT

Odor sources in wastewater treatment are generally related to the influent organic material and solids handling processes. These include raw influent pump stations, preliminary treatment, primary clarifiers, and solids handling facilities. Other areas which can generate odors are typically related to basins that are out of service, or where solids can accumulate for an extended period of time.

The most common complaint that wastewater agencies encounter arises out of areas producing hydrogen sulfide gas (H_2S) or the decomposition of organic material. Even at low levels hydrogen sulfide generates a distinct, potentially offensive odor. As wastewater travels through the collection system, the organic material begins the process of decomposition, which is performed by bacteria within the raw wastewater. Wastewater from collection systems with longer detention times or higher water temperatures have greater levels of decomposition prior to entering the treatment facility. The bacteria utilize sulfate for respiration, the byproduct of which is H_2S gas. H_2S is commonly released within the raw sewage pump station and preliminary treatment facilities (screening and grit removal) as it exits the collection system.

The odors attributed to primary treatment facilities (sedimentation basins) are typically not offensive due to the quiescent nature of the process. However, weirs and launders at the end of the process are a potential source due to turbulent conditions. This process is also the first time the wastewater is open to atmosphere which may contribute to an increased potential for hydrogen-sulfide release.

Secondary treatment is a biological process designed to create a controlled environment where microorganisms metabolize organic material and convert nutrients (nitrogen and phosphorus compounds). These processes are typically completed under aerobic conditions and do not emit offensive odors. Tertiary treatment processes are designed to remove fine solids from the effluent prior to discharge, and also do not result in offensive odors under normal operating conditions.

Solids settled in primary treatment and generated in the secondary process are stabilized prior to land application on agricultural ground as fertilizer. Solids handling processes have the potential to generate odors. However, a well digested sludge is typically considered to emit a mild, earthy scent similar to freshly turned topsoil.

The Glenbard Wastewater Authority treatment facilities include all of the processes described above. Over the last 40 years the Authority has, and continues to, upgrade its facilities to manage and reduce the potential for nuisance odors generated during wastewater treatment processes. These upgrades include covering areas where odors are generated, installation of equipment specifically designed to treat odor compounds, and installation of odor neutralizing fogging systems.

6.3 Review of 2017 Air Quality Sampling

In September 2017, air sampling and laboratory analysis was performed at key locations throughout the Wastewater Treatment Plant to help identify the sources of the odors, as well as the composition. The locations that were selected at the WWTP were key locations that were generating or had the potential to generate strong and/or offensive odors.

6.3.1 Odor Testing Protocol

The samples were taken using a Vac'Scent vacuum chamber to fill conditioned Tedlar bags. Air samples for the laboratory analyses were collected in three (3) liter Tedlar bags using a vacuum chamber and battery-operated pump.

One of the first steps within the collection process is to setup the equipment to take a sample, and then fill the container with air from the source. At the time the sample is taken, it is then evacuated completely to remove any background odors that could result in poor results. Once the container is completely empty, the container is refilled. After the bag has been filled, the test is complete, the bag is sealed, and placed into boxes for overnight shipping to Mayfly laboratory in Mystic, Connecticut for laboratory analysis. For the testing that was competed for the Authority, analyses included full Volatile Sulfur Compound and Volatile Organic Compound scans.

6.3.2 Sampling Locations

- Over the cover of the foaming anaerobic digester below the top of wall elevation **–** 1 D1
- Directly outside the Sludge Dewatering Building east entrance **-** 2 D1
- Along the southern property fence, near the Sludge Drying Beds - 1 D2
- Along the southern property fence, near the Sludge Thickener **-** 2 D2
- Off-site at Village Green Park (Control) - 3 D2

6.3.3 Sampling Results

The four most commonly occurring odor-generating constituents found at wastewater treatment facilities are hydrogen sulfide (H_2S), Carbonyl Sulfide (COS), Methanethiol or Methyl Mercaptan (CH_3SH), and ammonia (NH_3). The table below includes results for each of these four parameters:

Table 6-1: Air Quality Sampling Results Summary

Location	Laboratory Testing			
	H_2S (ppb)	COS (ppb)	MM (ppb)	NH_3 (ppb)
Anaerobic Digester #2	<5	<3	<3	<5
Sludge Dewatering Building	<5	3.5	<3	<5
South Fence Line - Gravity Thickener	<5	<3	<3	<5
South Fence Line - Drying Beds	<5	<3	<3	<5
Village Green Park (Control)	<5	3.4	<3	<5

During the air sampling, the Glenbard Wastewater Treatment Facility was experiencing a minor upset, and it is likely that odor generating compounds were resulting from an incomplete digestion process. This is further demonstrated by the absence of volatile sulfur compounds present in the laboratory analysis. As shown in the preceding table, each of the five sampling locations came back with less than 5.0 ppb H2S present. The laboratory detection threshold for hydrogen sulfide is 5.0 ppb and above; this should not be taken to mean there is no H2S present, only that it is below the equipment detection threshold. According to Mayfly Laboratories, the Odor Threshold (where 50% of a human panel can detect the presence of an odor) for hydrogen sulfide is 0.4 ppb. Therefore, H2S can be detected in the human population before it can be quantified through traditional laboratory testing.

The NIOSH Hazard Guide states that the Recommended Exposure Limit for H2S is 10.0 ppm. This is 2,000 times more concentrated that the laboratory detection limit, and 25,000 times more concentrated that the Odor Threshold. While an odor may be detectable by a human panel, it was found to be below the laboratory threshold and significantly below concentrations found to be dangerous by NIOSH/OSHA.

Carbonyl Sulfide was found at detectable levels outside of the Sludge Dewatering Building, at a concentration of 3.5 ppb. This is not anticipated to be of concern as the control sample taken at Village Green Park returned a concentration of 3.4 ppb. Additionally, the Odor Threshold for Carbonyl Sulfide is 55 ppb, and therefore it is not likely to contribute to nuisance odors.

Table 6-2 below and Table 6-3 on the following page include all Volatile Organic Compounds tested with the respective NIOSH REL included (if published). While a number of VOC's were found to be present, none exceeded or approached the NIOSH REL. Note that the NIOSH REL values as well as the laboratory results are reported in parts per billion (ppb).

Table 6-2: 2017 Air Quality Sampling Results - Volatile Organic Compounds

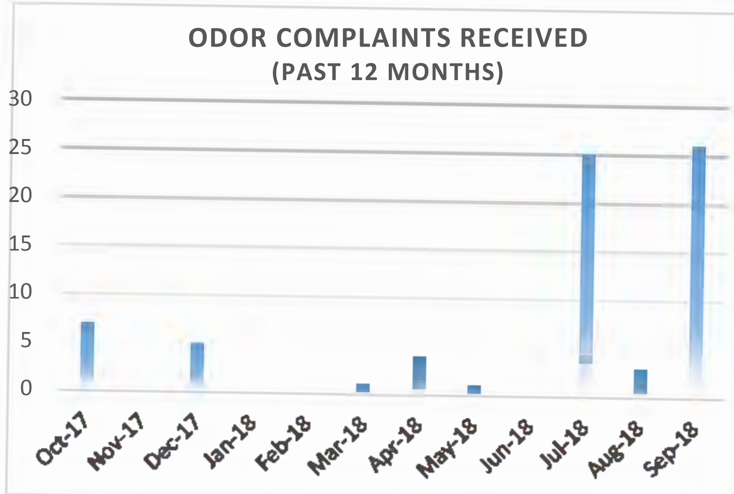
Aromatic Compound	NIOSH REL	Digst 1 D1 12:00	Sldg Dew 2 D1 12:15	Sldg Bed 1 D2 11:45 AM	Sldg Thck 2 D2 12:00	Cont 3 D2 12:30
	PPB	PPB	PPB	PPB	PPB	PPB
Benzene	100	**5.86**	**0.59**	**0.63**	**1.01**	**2.12**
Toluene	100,000	**5.69**	**1.35**	**2.90**	**3.73**	**3.00**
Ethyl Benzene	100,000	**23.1**	**0.52**	**0.48**	**0.91**	**0.69**
O,P-Xylene	100,000	**2.56**	**1.16**	**1.07**	**2.24**	**1.62**
M-Xylene	100,000	**17.7**	**0.72**	**0.74**	**1.58**	**1.04**
Styrene	50,000	**1.02**	**0.18**	**0.23**	**0.18**	**0.18**
Propyl Benzene	N/A	**2.31**	**0.24**	**0.29**	**0.65**	**0.97**
4-Ethyl Benzene	100,000	**1.90**	**0.19**	**<0.1**	**<0.1**	**0.25**
1,3,5-Trimethyl benzene	25,000	**13.4**	**1.26**	**1.02**	**0.44**	**0.28**
1,2,3-Trimethyl benzene	25,000	**0.98**	**0.18**	**0.29**	**1.87**	**1.20**
Decahydro-2,3-Naphthalene	N/A	**0.21**	**<0.1**	**<0.1**	**<0.1**	**0.11**
Naphthalene	10,000	**<0.1**	**1.21**	**0.04**	**0.02**	**0.96**
Halogen Compounds (No Halogen Compounds Detected)						
Hydrocarbons						
Pentane	120,000	**4.07**	**0.08**	**0.16**	**0.94**	**0.49**
Trimethyl Octane	N/A	**0.55**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
2,6,10-TrimethylDodecane	N/A	**0.53**	**0.36**	**0.38**	**0.35**	**0.33**
Ethyl Methyl Octane	N/A	**0.70**	**0.21**	**1.00**	**0.24**	**0.26**
DimethylOctane	N/A	**0.28**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
2,4-Dimethyl-1-Decene	N/A	**0.24**	**0.20**	**0.17**	**<0.1**	**0.16**
Tridecane	N/A	**0.16**	**4.29**	**0.68**	**0.03**	**1.00**
Tridecane	N/A	**0.18**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
Oxygen Compounds						
Ethanol	1,000,000	**8.04**	**<0.1**	**6.89**	**9.21**	**4.24**
Acetone	250,000	**246.0**	**17.3**	**22.9**	**32.4**	**14.0**
Isopropyl Alcohol	400,000	**96.2**	**17.2**	**5.77**	**8.39**	**197**
1-Propanol	200,000	**11.5**	**0.27**	**0.48**	**0.14**	**0.19**
Methyl Butanone	200,000	**<0.1**	**1.29**	**1.32**	**1.26**	**0.83**
Methyl Ethyl Ketone	200,000	**<0.1**	**<0.1**	**0.85**	**0.71**	**0.53**
Ethyl Acetate	400,000	**14.9**	**1.68**	**1.25**	**2.25**	**0.95**
2-Methyl-1-Propanol	50,000	**2.70**	**0.23**	**<0.1**	**0.21**	**0.29**
1-Butanol	50,000	**3.06**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
Propyl Acetate	200,000	**8.20**	**<0.1**	**<0.1**	**0.65**	**0.39**
Pentyl Furan	N/A	**9.82**	**0.33**	**0.38**	**0.34**	**0.44**

Table 6-3: 2017 Air Quality Sampling Results - Volatile Organic Compounds (continued)

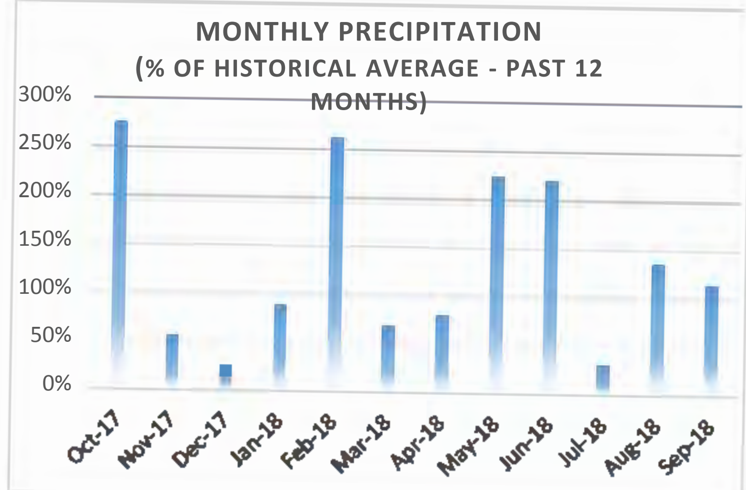
Aldehydes Compound	NIOSH REL	Digst	Sldg Dew	Sldg Bed	Sldg Thck	Cont
		1 D1	2 D1	1 D2	2 D2	3 D2
		12:00	12:15	11:45 AM	12:00	12:30
	PPB	PPB	PPB	PPB	PPB	PPB
2-Ethyl Butanal	N/A	**13.5**	**0.37**	**1.12**	**0.94**	**0.69**
1-Pentanal (Isovaleraldehyde)	50,000	**0.66**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
Hexanal (5-ppb)	N/A	**1.57**	**<0.1**	**0.29**	**0.24**	**0.21**
Furfural	N/A	**<0.1**	**<0.1**	**0.12**	**0.26**	**<0.1**
Heptanal	N/A	**0.38**	**<0.1**	**<0.1**	**<0.1**	**<0.1**
5-Methyl Furfural	N/A	**38.9**	**5.24**	**4.25**	**4.23**	**2.37**
Benzaldehyde	N/A	**0.29**	**0.38**	**0.29**	**<0.1**	**<0.1**
Octanal	N/A	**23.8**	**0.44**	**0.76**	**0.51**	**0.57**
Nonanal	N/A	**13.1**	**1.13**	**1.10**	**1.02**	**0.97**
Decanal	N/A	**<0.1**	**0.13**	**<0.1**	**0.28**	**0.19**
Fatty Acids						
Acetic Acid	10,000	**413**	**39.5**	**34.3**	**56.4**	**46.2**
Propanoic Acid	10,000	**5.74**	**9.55**	**6.58**	**7.95**	**10.1**
N-Butyric Acid (Butanoic Acid)	N/A	**77.8**	**4.19**	**2.21**	**2.82**	**3.74**
Propyl 2-Methyl Butanoate	N/A	**9.32**	**0.35**	**0.35**	**<0.1**	**0.36**
Valeric Acid (Pentanoic Acid)	N/A	**28.7**	**0.69**	**0.44**	**0.33**	**0.44**
Hexanoic Acid	N/A	**122**	**0.26**	**1.05**	**1.78**	**1.53**
Heptanoic Acid	N/A	**21.4**	**0.39**	**0.59**	**0.66**	**0.45**
Octanoic Acid	N/A	**54.2**	**1.26**	**2.78**	**1.54**	**2.54**
Nananoic Acid	N/A	**29.0**	**0.75**	**1.13**	**0.83**	**1.23**
Decanoic Acid	N/A	**27.7**	**0.74**	**3.06**	**0.87**	**2.46**
N-Hexadecanoic Acid	N/A	**2.13**	**11.51**	**2.06**	**3.84**	**7.95**
Decanal Acid	N/A	**27.9**	**1.72**	**4.19**	**1.11**	**3.89**
Dibutyl Ester Decanedioic Acid	N/A	**15.7**	**3.04**	**3.95**	**1.91**	**3.94**
Sulfur Compounds (See VSC Table)						
Nitrogen Compounds						
Ammonia	25,000	<0.5	<0.5	<0.5	<0.5	<0.5
Trimethylamine (OT 0.2 ppb)	N/A	**<1 PPB**	**<1 PPB**	**<1 PPB**	**<1 PPB**	**<1 PPB**
Terpenes & Fragrance Compounds						
ά-Pinene	N/A	**1.26**	**0.18**	**0.22**	**0.19**	**0.26**
Camphene	N/A	**1.49**	**0.13**	**0.11**	**0.13**	**0.22**
3-Carene	N/A	**1.30**	**0.24**	**<0.1**	**0.36**	**0.28**
Limonene	N/A	**3.03**	**0.45**	**1.79**	**0.89**	**0.48**

6.4 Review of Odor Complaints

The Authority provided electronic documentation of odor complaints for the past 12 months. Prior to 2017, the Authority would manually log the complaints and the total quantity would be approximately five to six per year on average. A number of complaints were received during July, August, and September of 2017 related to the previously discussed anaerobic digester upset. These complaints were specific to this incident and omitted from further consideration for capital projects as the source and cause is known. The table below illustrates the number of complaints received for each month over the past year.

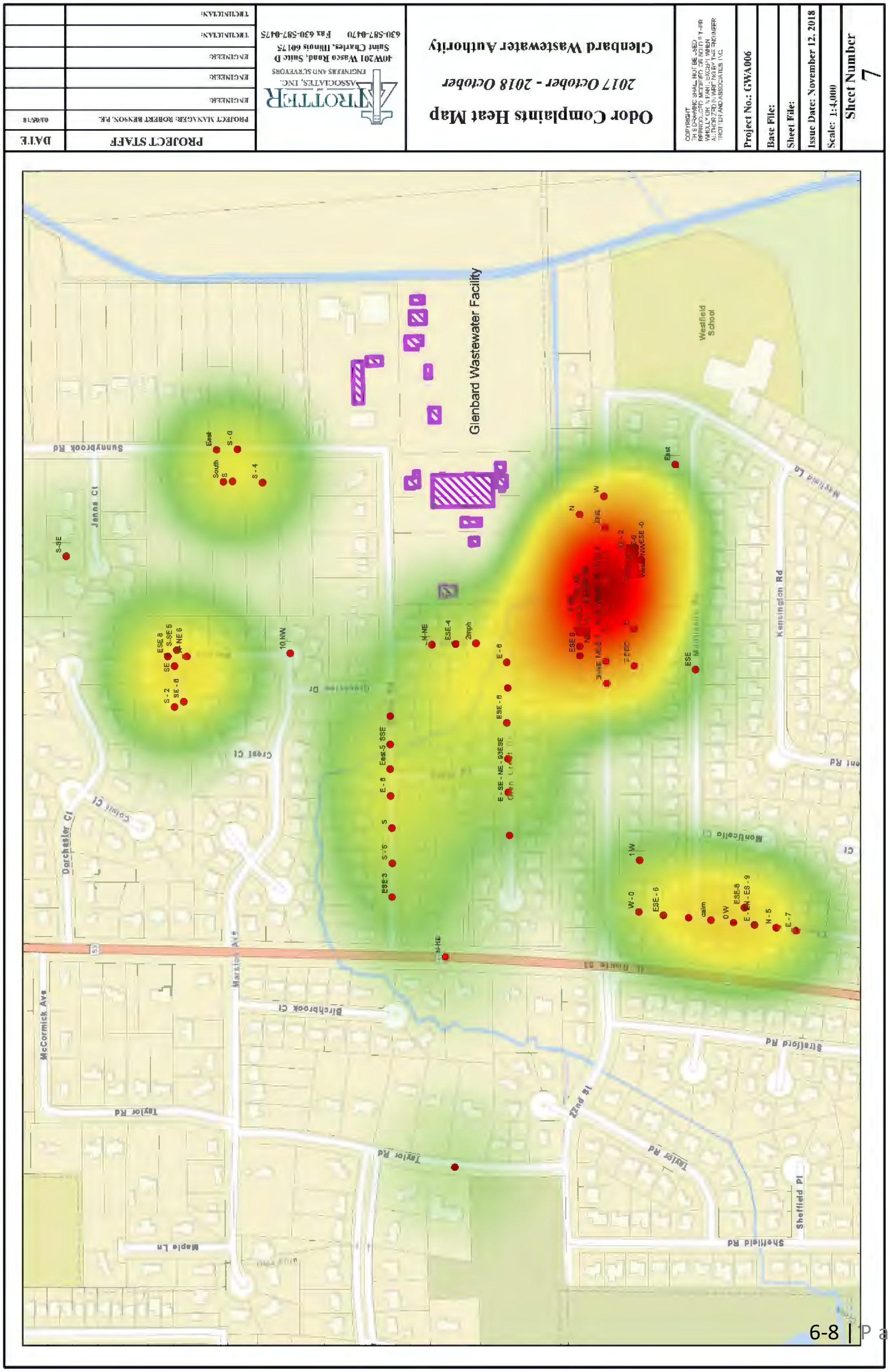


A total of 75 resident complaints have been received over the past 12 months, however these have been primarily isolated to July and September of 2018. These occurrences can be directly correlated to low influent flow periods as a result of dry weather stretches. Dry weather results in higher concentrations of organic loads due to reduced I&I dilution, and extended detention times within the collection system. This leads to degradation of organics within the wastewater. This degradation releases hydrogen sulfide (H_2S) as a by-product. As previously discussed, H_2S is detectable at extremely low concentrations and is released when the influent wastewater enters the plant and is agitated during pumping, screening, and grit removal.



The chart to the right illustrates the precipitation received as a percentage of the historical monthly average. During summer months elevated water temperatures, coupled with low flows, result in additional H_2S generated within the collection system and released upon entering the plant. This is specifically noted during July of 2018, as well as the last three weeks of September 2018 when the majority of resident complaints were received (the first week of September received significantly higher than average rainfall, however).

Analysis of this data shows that nuisance odors originating from the wastewater treatment facility are likely directly related to the organic strength of the influent raw sewage. This is in contrast to many treatment facilities where nuisance odors are the result of equipment or operational failure. While some complaints are directly tied to operational issues (e.g. draining tanks for cleaning) it appears the largest contributing factor is the naturally occurring byproduct of degradation within the collection system. This information is utilized in the analysis of potential capital projects for further odor reduction.

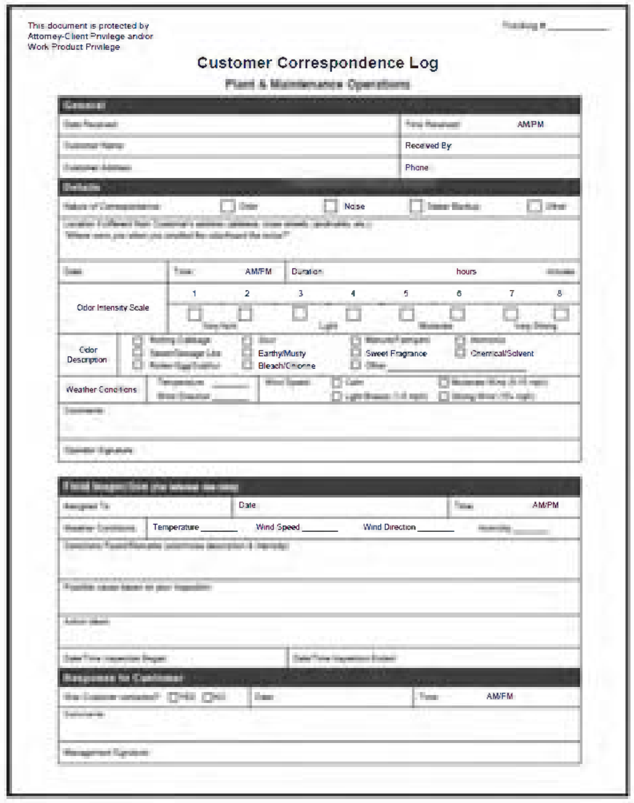

Odor Complaints Heat Map
2017 October - 2018 October
Glenbard Wastewater Authority
TROTTER ASSOCIATES, INC.
ENGINEERS AND SURVEYORS
40W201 Wasco Road, Suite D
Saint Charles, Illinois 60175
630-587-0470 Fax 630-587-0475
PROJECT STAFF
DATE
PROJECT MANAGER: ROBERT BENSON, P.E.
03/05/18
ENGINEER:
TECHNICIAN:
Project No.: GWA006
Base File:
Sheet File:
Issue Date: November 12, 2018
Scale: 1:4,000
Sheet Number
7
Glenbard Wastewater Facility
Westfield School
Sheffield Rd
Taylor Rd
Stratford Rd
Birchbrook Ct
Maple Ln
McCormick Ave
Marston Ave
Dorchester Ct
Crest Ct
Sunnybrook Rd
Jenna Ct
Monticello Ct
Kensington Rd
Mayfield Ln
IL Route 53

6.4.1 Customer Correspondence Recommendations

While reviewing and discussing the Authority's resident complaint log it was determined that the current procedures for receiving and responding to complaints should be reviewed. The information taken and the response varied by the staff member who received the phone call. A standard operating procedure (SOP) was developed for use by GWA staff when resident correspondence is received. The SOP includes protocol for intake of the correspondence, inspection of the location of odor/noise/etc., follow-up with the resident if necessary, and logging of all correspondence for future tracking.

In addition to development of the SOP, the form for resident/customer correspondence was updated and expanded. The form includes four sections:

- General – Includes basic information about the resident and staff member who took the correspondence.
- Details – Identifies the location where the issue was noticed by the customer, odor intensity scale and description (if it is an odor complaint), weather conditions, and staff member comments.
- Field Inspection – If a field inspection is required, this section allows for detailing of the conditions found, possible cause for the issue, and actions taken by the staff member.
- Resident Response – Includes information regarding follow-up with the customer and management sign-off.


This document is protected by
Attorney-Client Privilege and/or
Work Product Privilege

Customer Correspondence Log

Plant & Maintenance Operations

General

AM/PM

Received By

Phone

Details

Odor

Noise

Other

AM/PM

Duration

hours

Odor Intensity Scale

1 2 3 4 5 6 7 8

Odor Description

Earthy/Musty

Bleach/Chlorine

Sweet Fragrance

Chemical/Solvent

Weather Conditions

Date

AM/PM

Temperature

Wind Speed

Wind Direction

AM/PM

In order to best assess the source and cause of any issues, it is important that residents provide as much of the above detail as possible. The procedures outlined in the SOP should be communicated to all staff members who receive resident correspondence. The revised Customer Correspondence Log and Standard Operating Procedure for responding correspondence can be found in full in Appendix A.

The Customer/Resident Correspondence Log will provide an archive of information that can be tracked as the Authority moves forward. This database will provide information necessary for the improvement of operations, as well as assist in design of any capital improvements. For example, if residents commonly observe a rotten egg odor near the grit removal process, a carbon filter may be appropriate for treatment as this is indicative of the presence of hydrogen sulfide. However, if the odors are generally categorized as manure/farmyard this is more indicative of mercaptans, which would require biological treatment for removal rather than carbon filtration.

6.5 EXISTING ODOR CONTROL FACILITIES

The Authority maintains existing odor control processes located throughout the plant, in areas with the greatest potential for odors. These facilities are located at the Grit Building, Primary Clarifiers, Final Clarifiers, as well as the Gravity Thickener. This odor control equipment has been upgraded over the past several years in response to growing concerns over the potential for odor.

Odor Neutralization

Atomization of an odor neutralizing agent, manufactured by Ecosorb®, is the odor control process used at the grit building, and primary clarifiers. The agent is mixed with water, pumped through hoses installed on the perimeter walls of the grit chambers, and primary clarifiers, and dispersed into the air through a nozzle system. This system treats odors by adhering to the compound and neutralizing it.

Nozzles atomize and disperse the Ecosorb® neutralizing agent at the gravity thickener via temporary units that are set around the perimeter. The portable units utilized the same mixing system as the grit building/primary clarifiers. The agent is mixed with water, pumped through hoses, and is dispersed into the air through a nozzle system.

Chemical Addition

The Authority also has the ability to add chemical to the influent raw wastewater to reduce odors at the preliminary stages of treatment. This chemical addition is through the SRI lift station and utilizes Ferric Chloride. This iron salt oxidizes odor-generating sulfides to sulfur, and precipitates dissolved sulfides to form ferrous sulfide. This process has been suspended due to operational issues experienced at the plant due to the addition. Mainly, the Authority experienced issues with UV disinfection and the transmissivity of UV due to the bulbs being stained. Additionally, the chemical addition was found to be somewhat ineffective due to the minimal mixing time.

Physical Barriers

The Authority has also installed physical means of preventing odors from escaping unit processes. In 2017 GWA installed passive odor control systems at their final clarifiers in the form of fiberglass launder (effluent trough) covers. These barriers were installed around the entirety of each of the four clarifiers and reduce the potential for odors generated when effluent cascades over the weirs and into the trough.

6.6 ADDITIONAL ODOR CONTROL EFFORTS

In addition to the odor control systems specifically targeting emissions from the treatment process, the Glenbard Wastewater Authority has also implemented several operational procedures and selected infrastructure that reduce the impact of odors. While these modifications are not capital level improvements, they represent a concerted effort to reducing the potential for nuisance odors.

- Modifications to the High Strength Waste (HSW) Acceptance Program:
    1. Shortened/limited the amount of High Strength Waste Deliveries to 7:00am-4:00pm, as well as limiting the total intake of HSW to 15,000 gallons per day or approximately 300,000 gallons per month. While this reduces revenue generated by the HSW acceptance program, it provides a safeguard against anaerobic digester upsets.
    2. Washing down the HSW receiving box, containment pad, and removal of screenings after each delivery.
    3. Installed additional pumps to allow for slower and steadier feed of HSW to the digesters.
- Ceased acceptance of landfill leachate during low-flow periods.
- Increased potency and quantity of odor neutralizing atomization system at the grit removal, primary clarifiers, and gravity thickener processes. Also purchased additional portable odor neutralizing units for deployment as needed.
- Disinfect non-potable water with liquid chlorine. Non-potable water is used to wash down and clean tanks and to control floating, odor-causing scum, etc. Disinfection reduces the growth of bacteria which can cause odors resulting from degradation of organics.
- Installation of low-profile covers over grit tanks, West Glen Ellyn Interceptor flume, CRAS return flume, and the influent side of the carbo Unox deck.
- Installation of grit and screenings washing and compacting equipment to reduce the water and organic content which allows less decomposition and odor production during storage.
- Dewatered sludge (biosolids) is hauled offsite daily rather than storing on sludge drying beds. While biosolids typically do not have an objectionable odor, this is done out of caution.
- The Raw Sewage Pump Station Improvements are designed such that the low liquid level will allow for improved drainage of the influent sewers, resulting in less stagnation of raw wastewater.
- Exhaust fans in buildings which may produce odors (preliminary treatment, gravity thickener) are shut off in evening hours when possible.
- Adding freshener water to tanks with greatest odor potential to decrease stagnation.
- Increased frequency of tank and equipment cleaning during low-flow periods.
- Staff periodically perform routine odor checks in areas adjacent to the plant to proactively identify issues before impacting residential neighbors.
- Daily operator meetings which can include review of odor control methods and recent complaints.
- Yearly inspection of the digester gas system to verify proper pressure set points to prevent the pressure relief valves from opening unnecessarily.

6.7 POTENTIAL ODOR SOURCES FOR FURTHER REVIEW

The project team conducted an evaluation of the existing wastewater treatment plant to determine where odors are potentially being generated and emitted from the process. Through site visits, a review of complaint reports, review of the 2017 Air Quality Sampling Memorandum, and discussions with plant staff, the team divided the treatment processes into four categories based on the potential for odors.
The phases of treatment with **high** potential for objectionable odors were found to include:

- Screening Facility
- Primary Sedimentation Tanks
- Grit Tanks/Removal
- Gravity Thickener
- Solids stabilization (anaerobic digestion)
- Intermediate Clarification/RAS T-Valves

The phases of treatment with **moderate** potential for objectionable odors were found to include:

- High Strength Waste Receiving Station
- Belt Filter Press (dewatering) Building
- Sludge Drying Beds/Storage

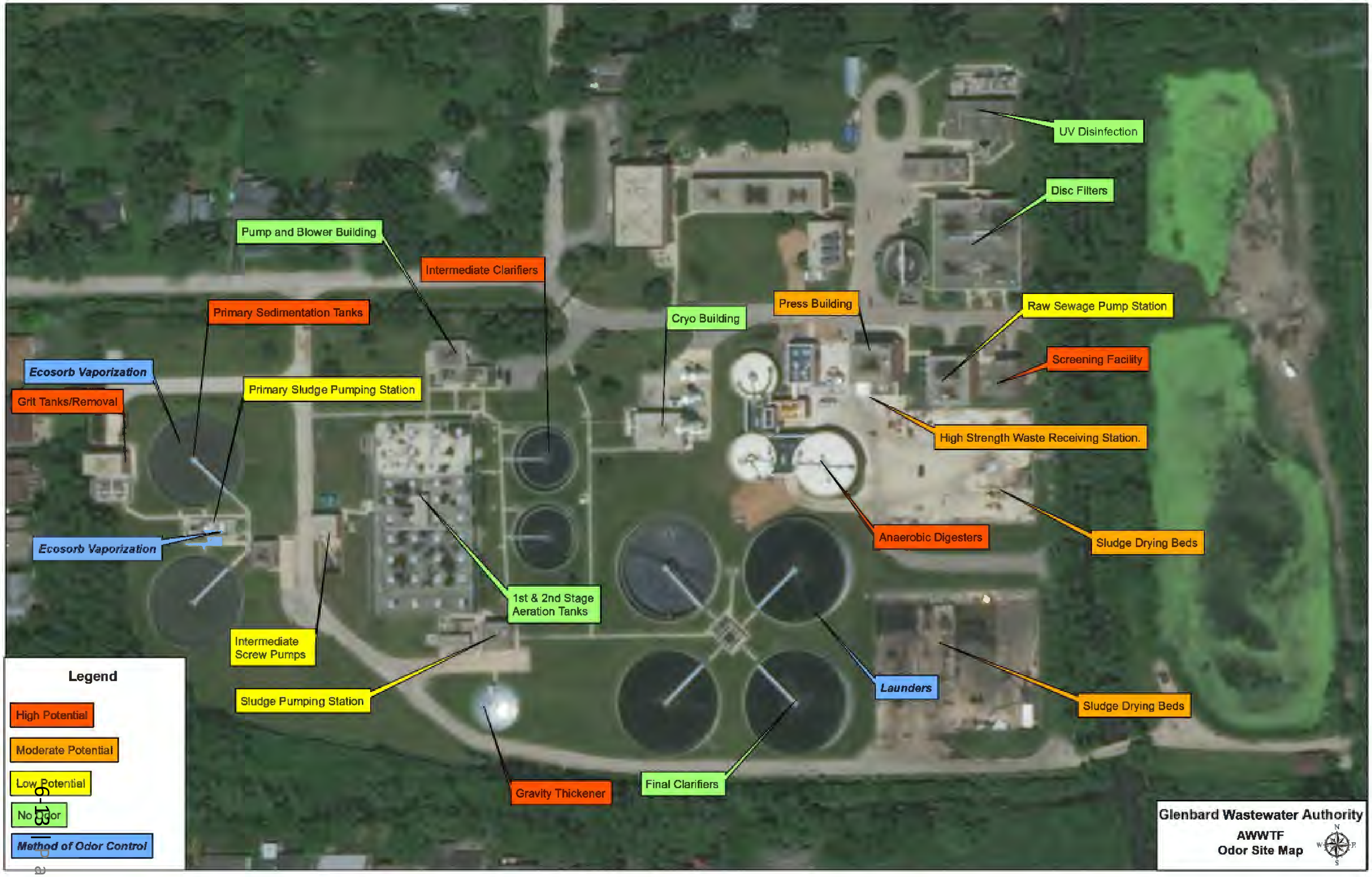
The phases of treatment with a **low** potential for offensive odors include:

- Raw Sewage Pump Station
- Intermediate Screw Pump Station
- Sludge Pumping Station

The phases of treatment that **do not cause** odors were found to include:

- Cryogenic Building
- Pump and Blower Building
- Biological process (1st/2nd Stage Aeration Tanks)
- Final Clarification
- Tertiary (Disc) Filtration
- Disinfection (UV)

The 'Potential Odor Site Map' included on the following page identifies the treatment processes, the odor ratings, and the odor control systems currently in place.

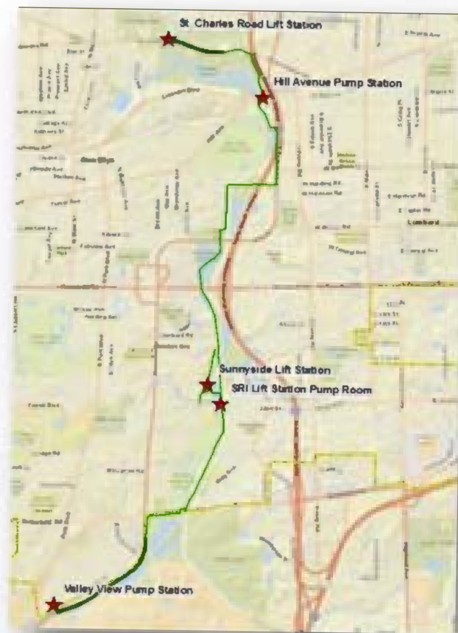

UV Disinfection
Disc Filters
Pump and Blower Building
Intermediate Clarifiers
Primary Sedimentation Tanks
Press Building
Cryo Building
Raw Sewage Pump Station
Screening Facility
Ecosorb Vaporization
Grit Tanks/Removal
Primary Sludge Pumping Station
High Strength Waste Receiving Station.
Anaerobic Digesters
Sludge Drying Beds
Ecosorb Vaporization
1st & 2nd Stage Aeration Tanks
Intermediate Screw Pumps
Launders
Sludge Pumping Station
Sludge Drying Beds
Gravity Thickener
Final Clarifiers
Legend
High Potential
Moderate Potential
Low Potential
No Odor
Method of Odor Control
Glenbard Wastewater Authority
AWWTF
Odor Site Map

6.8 RECOMMENDED IMPROVEMENTS

Based on the assessment of odors from the various treatment processes, the project team documented areas where additional analysis may be required or where steps could be taken to enhance odor control. There were six processes identified as having a "High" potential to generate odors, and an additional three with a "Moderate" potential. Strategies for future odor control will focus on these nine processes. Two categories of potential strategies were considered – operational adjustments/in-house projects with immediate results and low implementation cost, and long-term more complex projects capital projects.

6.8.1 Operational Adjustments/In-House Projects

Collection System Measures



Previously, the Authority had the capability to add ferric chloride to the influent wastewater at the SRI Lift station. The system would pump ferric chloride into the wet well during low flows to reduce the potential for odors associated with hydrogen sulfide release. This system included small totes for the ferric chloride storage, as well as peristaltic pumps for dosing. At this time the pumps have failed, and the system would require some minor improvements to become operational once more. The use of ferric was found to be somewhat ineffective due to the short mixing times present.

Performance of a chemical as a method of odor control is dependent on the dosage, compounds present, and impacts on downstream processes. Several alternative chemicals may be utilized including iron salts, hydrogen peroxide, potassium permanganate, nitrates, and ozone. Chlorine dioxide is a strong oxidant capable of oxidizing hydrogen sulfide and other organic odor-producing compounds. It is fast reacting, making it advantageous for short term sulfide control. However, chlorine is not sulfide specific and the majority of the chemical is lost to competing reactions. Careful dosage control is also required to avoid harmful byproduct generation that could impact downstream biological processes. Iron salts such as ferric chloride do not react with organics and instead forms precipitates with these compounds. However, iron salts increase corrosion of existing equipment and increase maintenance costs. These iron salts also require a longer mixing period to be highly effective.

Further analysis should be completed to investigate dosing of peroxide or other biological-based additives to reduce the level of solids degradation occurring within the collection system. Dosing locations throughout the collection system could be implemented at the Authority's five lift stations. Dosing of the lift station wet wells could be performed during periods of low flows (e.g. daily total flows less than 8.5 MGD for two consecutive days during summer months). As a result, the Authority would be proactively addressing the potential for odors as opposed to reactively starting to dose when odors may be present. The estimated costs for installation of equipment required at each lift station is approximately $100,000, or a total project cost of $500,000 to implement dosing capabilities at all five stations.

Low Flow System Flushing

As stated previously, during summer months elevated water temperatures, coupled with low flows, result in additional H_2S potentially being generated within the collection system and released upon entering the plant. One option that could be considered by Glen Ellyn and Lombard would be to invest in a connection from the existing stand-by wells that are being maintained by the Villages to the collection system/interceptor sewers. During low flow periods in the summer, or as flows subside to the treatment facility, the standby wells could be run and wasted directly to the collection system. This would help increase the influent flows to the treatment facility with clean water that is particularly cold in nature to help mitigate the H_2S potential.

However, this modification would also have additional operational costs for Glen Ellyn, Lombard, and the Authority in regard to treatment and pumpage. In addition, the tributary collection system would also need to be evaluated to ensure capacity is available for a direct discharge from the wells due to the high volume of flow that could be discharged. It is also recommended that the Authority review the wells for discharge levels of chlorides, radium, etc., as they could impact the Authority's discharge permit.

Anaerobic Digester

Digester gas is a by-product of the anaerobic stabilization process. The majority of gas is methane and carbon dioxide which have no odor; however, the remainder includes sulfide compounds which have the potential for offensive odors. The covers on the existing primary digesters include pressure relief valves. These valves are intended to operate only under emergency conditions when the pressure within the digester exceeds recommended levels. Upon startup of the Vaughan Rotamix sludge mixing systems, gas that has been entrained within the sludge is released. This sudden release of gas increases the pressure under the digester cover and it has been noted that the pressure relief valves tend to open releasing digester gas to the atmosphere.

The system is operated intermittently due to foaming issues associated with continuous mixing. Foaming events are another source of odor. Since the pressure relief valves are intended to open only under emergency situations, it is recommended that the digester gas system be further evaluated to determine the condition and conveyance capacity of the gas piping as well as to determine the proper pressure set points to prevent the pressure relief valves from opening unnecessarily. This evaluation could be completed by Varec Biogas field technicians and is estimated to cost no more than $10,000. The Authority currently participates in this program, and Varec has recently been out to review their equipment and verify that it is operating as intended.

Sludge Dewatering Facilities

The existing sludge dewatering facilities include belt filter presses, polymer units, and conveyors. The solids concentration of the anaerobic sludge is increased from 2.5% to 18% within the dewatering facility. The filtrate (waste liquid stream) contains a high concentration of ammonia, which can potentially cause odors. The dewatered solids are conveyed to a truck and hauled directly offsite (effective February 2018).

The Authority operates the dewatering facility seven days per week, and only during the day as the plant is not staffed overnight. As a result, if solids are not hauled offsite each day the truck is kept in the building overnight to reduce the potential for odors caused by biosolids stored outside overnight. If venting from the Dewatering Building becomes an issue due to overnight biosolids storage, the Authority could consider small drum scrubbers for installation downstream of exhaust fans (rooftop). These units do require relatively frequent replacement/recharge of media and would represent a maintenance labor cost.

Good Housekeeping/Best Management Practices

The Screening Building, Grit Building, and Press Building are of high priority due to the potential for odors generated within them. Whenever possible, windows and doors to buildings should remain closed, and building ventilation systems should be re-evaluated to minimize the discharge of odors. For example, continuous ventilation at a lower airflow may result in less objectionable odors due to dissipation upon discharge, as opposed to intermediate discharge of air with a higher odorous concentration.

The Authority staff should continue to conduct work sessions with operators and other staff to discuss the importance of recognizing, reporting and mitigating odors, as well as to revisit existing or develop new operation and maintenance procedures that will reduce the potential for odors. Some topics of discussion may include shut downs for maintenance, tank flushing and cleaning, and best management practices.

6.8.2 Long-Term Capital Projects

Preliminary/Primary Treatment

Preliminary treatment processes are typically major sources of odor emissions for liquid stream treatment, and generally consist of raw sewage pumps, grit removal, and screening. GWA has two separate facilities for raw sewage pumping, screening, and grit removal. The majority of the raw sewage pumping and screening is contained. Additionally, the grit building will have the HVAC system replaced as part of the Facilities Improvements Project. The system should meet ventilation requirements stated in Illinois Administrative Code Title 35, Part 370 for sufficient air changes per hour. Upgrades to the system should be implemented based on the inspection/balancing results.

GWA could also implement an active odor control system, as well as installing primary clarifier launder covers. With the installation of this new equipment, the HVAC from the Grit Building (shown in orange) could be rerouted to exhaust through the filter unit for treatment (shown in blue), as well as incorporating the air from under the clarifier launders (shown in orange). This scenario assumes a biological (Biorem) odor control unit would be installed. Alternative technologies are further reviewed in Section 2.3.

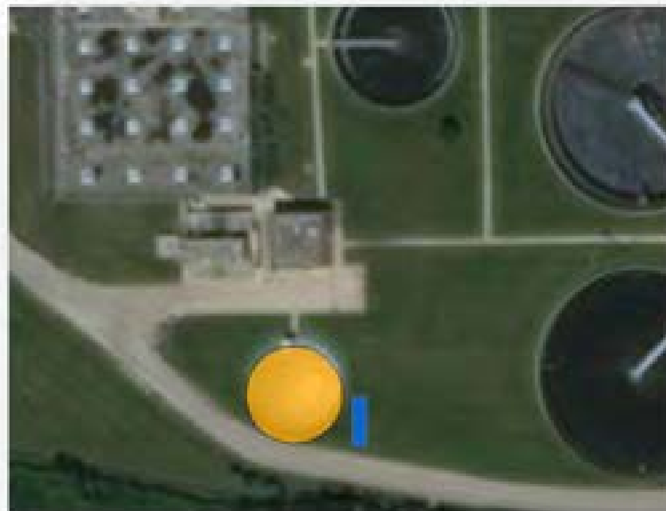
The Biorem unit would be located to the north of the existing grit building and would have air piping routed from the grit building, and launders to the new structure. The biological odor control unit, would consist of a concrete basin that would draw air from these locations, provide treatment, and exhaust to the atmosphere. The estimated construction cost for this project is approximately $1.6 Million. The estimated annual operation and maintenance cost is approximately $25,000 which consists primarily of additional power consumption and roughly one hour per week of labor for routine maintenance. This project could be split into two phases, Phase 1 installing the launder covers (est. $500,000), and Phase 2 installing the biofilter and equipment (est. $1,200,000).

Grit Building & Chamber				
Grit Building	30,200 cf @ 6 ac/hr	=	3,020 cfm	
Grit Chamber	11,200 cf @ 6 ac/hr	=	1,120 cfm	
			4,140 cfm	**use 4,300 cfm**
Primary Clarifiers				
Primary Clarifier Launders & Boxes	6,313 cf @ 6 ac/hr	=	630 cfm	
			630 cfm	**use 700 cfm**

Grit Building/Primary Clarifier Odor Control (Phase 1)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$53,828
SITEWORK	$7,250
PRIMARY CLARIFIER LAUNDER COVERS	$273,000
Construction Sub-Total	**$334,078**
Contingency @ 15%	$50,112
Engineering & Administration @ 15%	$57,628
PROBABLE PROJECT COST:	**$441,817**

Sludge Thickening – Alternative #1 (Gravity Thickener)

Waste activate sludge (WAS) is sent to the gravity thickener to increase the solids concentration prior to being added to the solids treatment process. The thickening process onsite consists of co-thickening primary sludge, and both carbo/nitro WAS within the existing gravity thickener located in the southwest corner of the treatment plant. The gravity thickener concentrates the WAS to approximately 3-4% solids concentration. Decant from the gravity thickener flows back to the head of the plant for treatment.



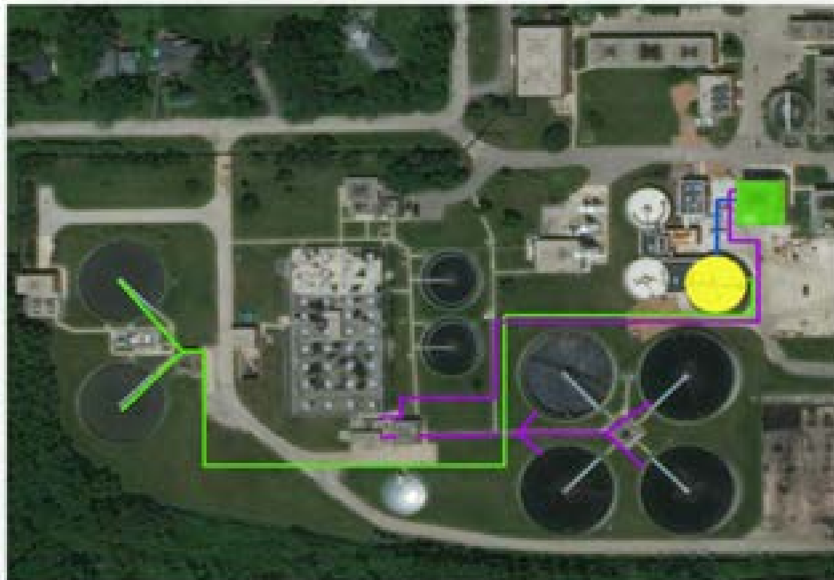
The gravity thickener consists of a concrete basin that is enclosed with an aluminum cover (shown in orange). The void area under the cover is ventilated to atmosphere to preserve the integrity of the mechanical equipment within, as well as the cover. The vented air is not treated prior to discharge, and as a result can be a source of concentrated discharge of potential odors.

Due to the nature of the air leaving the gravity thickener, the Authority could also utilize a biological odor control system for this structure. Air from under the cover could be evacuated from the structure and conveyed to a new odor control system (shown in blue). The treatment unit would be a standalone modular design and delivered onsite prefabricated. The filter would then be hooked up, tested, and online in a short duration. The project would include the installation of the prefabricated tank, as well as some minor site piping for water, as well as electricity. Exhaust from the odor control unit would be discharged to atmosphere. The anticipated cost for the project is approximately $800,000, and the annual O&M would be under $10,000.

Sludge Thickener				
Grit Building	16,000 cf @ 6 ac/hr	=	1,600 cfm	
			1,600 cfm	**use 2,000 cfm**

Sludge Thickening Odor Control - Alternative #1 (Gravity Thickener)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$125,514
SITEWORK	$6,250
BIOFILTER	$471,150
Construction Sub-Total	**$602,914**
Contingency @ 15%	$90,437
Engineering & Administration @ 15%	$104,003
PROBABLE PROJECT COST:	**$797,354**

Sludge Thickening – Alternative #2 (Gravity Belt Thickener)



The Authority recently completed pumping modifications to the primary sludge system, which allows for higher solids concentrations to be maintained. With these improvements the Authority is obtaining sludge concentration off of the primary clarifiers of approximately 3-4%. As a result, additional thickening is not necessary, and primary sludge could be sent directly to anaerobic digestion. Co-thickening the primary sludge with WAS can create septic conditions which may lead to nuisance odors and should be avoided if possible. In general, exposing primary sludge to atmosphere should be avoided to reduce the potential for objectionable odors. This would be the case for both gravity thickening as well as thickening across a gravity belt thickener.

The second alternative to sludge thickening includes separating the two sludges (primary and WAS) and ultimately eliminating the gravity thickener. The primary sludge could be redirected and pumped directly to the anaerobic digesters (piping shown in green, digester in yellow). In addition to rerouting the primary sludge, the WAS would be rerouted to the existing gravity belt thickener (GBT) located in the Dewatering Building for thickening (piping shown in purple, press building shown in green). In both cases piping modifications would be required to complete the reroute.

Prior to thickening across the gravity belt thickener, WAS from the final clarifiers would need to be pumped to a WAS storage tank, and therefore additional tankage would be required. Currently the old aerobic digesters adjacent to the Sludge Pumping Station are out of service and could be repurposed. The existing tanks would require some structural modifications, the existing interior concrete baffle walls would need to be demolished, and the structure would require the installation of an aeration system. The aeration system would be installed to mitigate any concerns of the sludge going septic and developing odors.

This project could be broken into two phases. Phase 1 would include repairing and replacing the primary sludge line to allow primary sludge to be fed directly to the anaerobic digesters and remove any cothickening onsite. WAS from the final clarifiers would continue to be fed to the gravity thickener, and fed to the anaerobic digesters as well. At the conclusion of phase one, the Authority would have two separate avenues to feed the digesters. Each method would keep the primary and secondary sludge separated, and help mitigate odor concerns. In addition to the piping modifications, an ECOSORB atomization system has been included as part of the project. The unit is scheduled to be installed on top of the gravity thickener near the exhaust fan to help mitigate any odors from the thickener itself.

Sludge Thickening Odor Control - Alternative #2 Phase 1	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$41,437
SITEWORK	$22,150
PRIMARY SLUDGE	$139,685
GRAVITY THICKENER	$59,500
Construction Sub-Total	**$262,772**
Contingency @ 15%	$39,416
Engineering & Administration @ 15%	$45,328
PROBABLE PROJECT COST:	**$347,515**

Phase 2 includes routing the waste activated sludge from the final clarifiers to the existing aerobic digesters that are out of service for WAS storage. WAS would then be pumped from the storage tank to the rehabilitated GBT and thickened. Upon thickening, the TWAS could be sent directly to the anaerobic digesters, however this may present the potential for overloading the digesters if fed a large volume over a short duration.

Alternatively, one of the TWAS holding tanks in the Dewatering Building that was converted to FOG receiving could be re-established as TWAS holding. Thickened sludge could then be fed to the digesters at a constant rate out of this holding tank. The estimated project cost for Phase 2 of the project is anticipated to be $1.2 Million.

Sludge Thickening Odor Control - Alternative #2 Phase 1C (WAS Holding and GBT)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$157,080
SITEWORK	$66,600
FINAL CLARIFIERS WAS	$197,760
SLUDGE THICKENING MODIFICATIONS	$175,000
WAS STORAGE TANK MODIFICATIONS	$325,000
Construction Sub-Total	**$921,440**
Contingency @ 15%	$138,216
Engineering & Administration @ 15%	$158,948
PROBABLE PROJECT COST:	**$1,218,604**

At the time that the Authority moves forward with phase two of the project, it is recommended that the existing GBT be budgeted for replacement. The existing GBT was installed in 2003 and is only anticipated to have approximately five years of service life remaining prior to replacement. The estimated cost for budgeting purposes would be $885,000.

Sludge Storage Barn – Alternative #1 (Existing Dewatering Process)

Currently, the Authority dewaters sludge on a consistent basis of seven days a week for approximately five hours each day. As part of this process, dewatered sludge or biosolids is produced and was previously stored in the southwest corner of the site on sludge drying beds. The designated area for solids storage consisted of a concrete pad without a structure.

In late 2017, the Authority elected to haul the biosolids daily, to eliminate any solids from being stored onsite. This operation is highly dependent upon weather (when the fields would be ready for application), road conditions (when weight limit restrictions for truck routes would be in place) and is operationally difficult to maintain.

An alternative option to daily hauling would be the construction of a full enclosed four-sided sludge storage barn. This structure would consist of concrete push walls (approximately 7-feet in height), a concrete slab, and a prefabricated metal structure. A single side of the structure would have multiple bay doors that could be opened when necessary to dump dewatered sludge in the barn, as well as haul solids offsite during the spring and fall. Due to the large capacity of the WWTP, this would require a structure that is approximately 250-feet by 200-feet. There are two potential site locations for the sludge storage barn (A & B). Option A (orange) is located on top of the existing sludge drying beds, this site may require additional investigation as an existing drainage ditch may need to be rerouted. Option B (yellow) is located where the excess flow storage ponds used to be located. This area allows for easy access, however is located closer to site boundaries.

The sludge storage barn is sized to allow for storage of up to 5,000 cubic yards of biosolids, which is adequate to meet the Authority's current biosolids production and provides enough storage capacity (150 days) for design loading of the treatment plant. The project cost is anticipated to be $5.9 Million.

Sludge Storage Alternative #1 (Existing Dewatering Process, No Odor Control)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$602,829
SITEWORK	$151,500
SLUDGE STORAGE BUILDING	$3,683,310
Construction Sub-Total	**$4,437,639**
Contingency @ 15%	$665,646
Engineering & Administration @ 15%	$765,493
PROBABLE PROJECT COST:	**$5,868,778**

However, due to the building being fully contained, it is recommended that an odor control unit be installed. By fully containing the building, odors will have the potential to concentrate and be released with the intermittent opening of the bays during hauling processes. In order to control the size of the odor control unit, the sludge storage structure would need to be divided up into bays to allow specific sections to be treated individually versus as a whole.

The odor control unit would only be used on one bay at a time. For example, if bay one is having biosolids hauled in or out, the odor control unit would be sized to accommodate that specific volume. The other bays would remain closed, and untreated. At the time that the other bays would be used, valving would be changed and air treatment could then be performed in the required area. The estimated project cost for the sludge storage barn and odor control system is approximately $12.0 Million.

Sludge Storage Barn				
Sludge Storage Building	1,250,000cf @ 6 ac/hr	=	25,000 cfm	
			25,000 cfm	**use 30,000 cfm**

Sludge Storage Alternative #1 (Existing Dewatering Process, with Odor Control)		
Description		Total Probable Cost
	SUMMARY	
GENERAL CONDITIONS		$1,304,843
SITEWORK		$151,500
SLUDGE STORAGE BUILDING		$3,996,060
SLUDGE STORAGE BUILDING ODOR CONTROL		$3,660,100
	Construction Sub-Total	**$9,112,503**
	Contingency @ 15%	$1,366,875
	Engineering & Administration @ 15%	$1,571,907
	PROBABLE PROJECT COST:	**$12,051,285**

The Authority currently does not experience odor generation issues as a result of the current trucking and hauling operations. This system presents operational challenges in coordinating third-party hauling but to date has been manageable. Typically, higher tipping fees are charged for an intermittent hauling system such as the Authority's. However, the GWA is currently paying approximately $19 per cubic yard of material hauled. To evaluate any savings associated with on-site storage and hauling 2-3 times per year, a survey of surrounding community's sludge disposal methods and costs was performed.

There were five methods of disposal between the 12 surrounding communities reviewed. The first is liquid hauling or using a contracted dewatering unit, which is unnecessary because the Authority owns dewatering equipment and does not have liquid storage available. The second disposal method was specific to St. Charles, who contracts with a local farmer to land apply on property owned by the City. This alternative is likely not feasible due to the location of the Authority's facility relative to available agricultural land, as well as the high capital cost of purchasing the required land.

Information provided by surrounding communities regarding their cost per cubic yard for biosolids hauling and disposal is as follows:

1. No on-site storage, contract hauled multiple times/week $16-23/CY
2. On-site storage, contract hauled 1-3x/year for land application $13-22/CY
3. Hauled to landfill $25-28/CY

The variation in these numbers is due to facility size, location, and proximity to a disposal site. The study found that communities more rural in nature have a lower cost to haul, as expected.

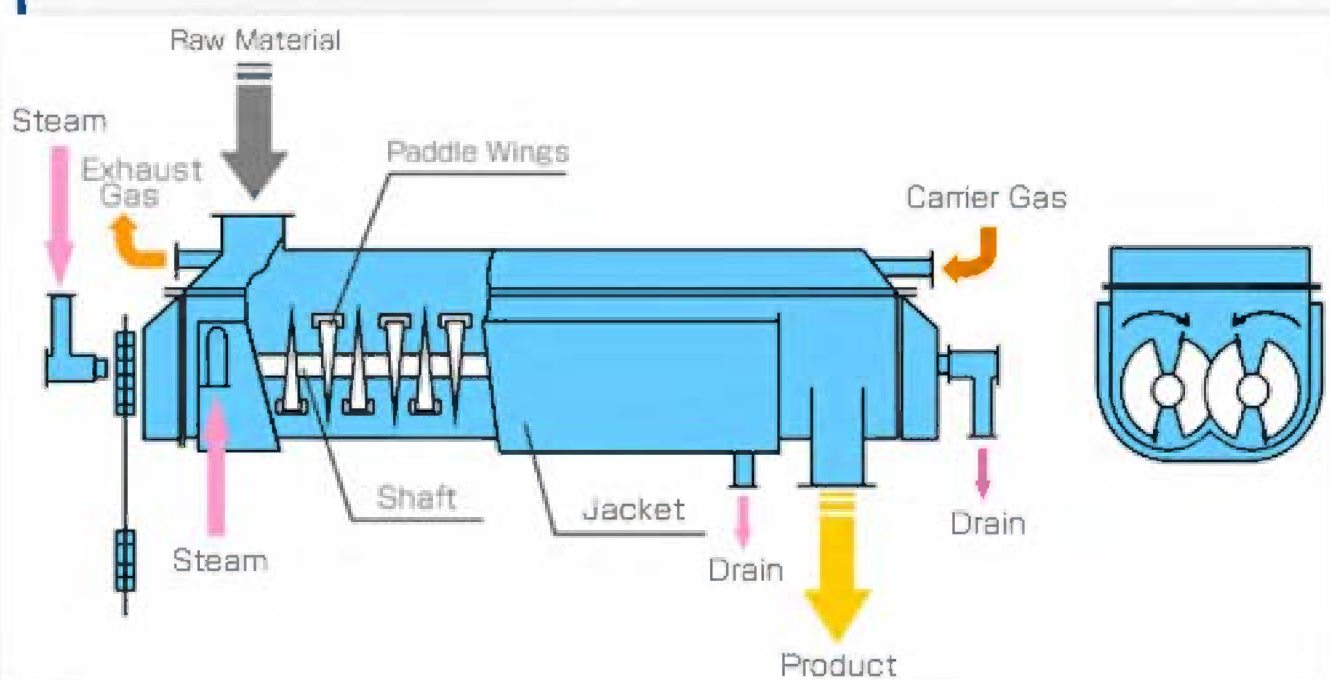
Community	Sludge Type	Disposal Method	Contractor
Hanover Park	Aerobically digested	Stored On-Site, Liquid Hauled or Dewatered by Contract Hauler 2x/Year	Synagro
St. Charles	Anaerobically digested and dewatered	Stored On-Site, Land Applied by Contract Farmer on City-Owned Agricultural Land	Local Farmer
Addison	Anaerobically digested and dewatered	Land Applied, Contract Hauler, 3x/Week	Synagro
Bloomingdale	Aerobically digested and dewatered	Land Applied, Contract Hauler, 3x/Week	Synagro
East Dundee	Aerobically digested and dewatered	Land Applied, Contract Hauler, 3x/Week	Synagro
Glenbard Wastewater	Anaerobically digested and dewatered	Land Applied, Contract Hauler, 3x/Week	Synagro
Bartlett	Aerobically digested and dewatered	Stored On-Site, Land Applied by Contract Hauler	Synagro
Fox Lake	Anaerobically digested and dewatered	Stored On-Site, Land Applied by Contract Hauler	Dahm Trucking
Roselle	Aerobically digested and dewatered	Stored On-Site, Land Applied by Contract Hauler	Synagro
Wheaton Sanitary District	Anaerobically digested and dewatered	Stored On-Site, Land Applied by Contract Hauler	Stewart Spreading
Batavia	Anaerobically digested and dewatered	Hauled to Landfill	Advanced Disposal
Carol Stream	Aerobically digested and dewatered	Hauled to Landfill	Advanced Disposal

The average cost per cubic yard for communities with on-site storage which haul 2-3 times per year was found to be $17.10. This would represent a savings of just under $2/CY if the Authority constructed on-site storage. At a minimum capital cost of $5.9M (without odor control) the payback in saving $2/CY would not provide an incentive to construct storage. Therefore, if the Authority finds the current practice of contract hauling acceptable, it is not recommended that storage be constructed at this time.

Sludge Storage Barn – Alternative #2 (Sludge Drying)

Due to the overall capital costs of the sludge storage facility and treatment of air, it is recommended that future evaluations consider sludge dryers. Sludge dryers utilize a heating media, such as oil, to heat metal paddles. The heat from the paddles is transferred to the sludge and water is evaporated. A dryer can produce Class A biosolids up to 92% solids, dramatically reducing the storage volume and disposal cost of sludge. For the sludge dryer to perform at this high level, it is recommended that the sludge fed to the dryer is dewatered using a centrifuge or belt filter press. The dryer the feed sludge is, the better the sludge dryer will perform.

Through the process of drying the sludge, the storage barn could be significantly decreased from about 50,000 square feet to 10,000 square feet assuming 90% solids concentration, and a sludge height of approximately six feet. However, this process has a high potential for odors, so the odor control process would still be recommended and sized for the entire footprint of the building. If this option is viable, the process would need to be further evaluated to identify building requirements, site piping, etc.



6.9 ODOR CONTROL TECHNOLOGY SUMMARY

There are a number of alternative technologies currently used for odor control in municipal wastewater treatment. These technologies range in capital cost, operations and maintenance costs, and constituent removal efficiencies. Selecting the optimal solution requires site-specific design considerations. The three technologies most commonly utilized for wastewater applications are activated carbon filtration, chemical scrubbing, and biofiltration. Additionally, photoionization is an emerging technology. Capital, operation and maintenance costs vary for the different technologies.

Activated Carbon Filtration

Several wastewater treatment facilities in the area operate PHOENIX® activated carbon filters manufactured by Continental Carbon (formerly Calgon Carbon). Activated carbon can effectively remove up to 99% of H_2S through an adsorption process. The air is passed over a bed of carbon which removes volatile organic compounds from the vapor phase. Carbon has a limited adsorptive surface area, however, and after it has reached its saturation point it must be recharged or replaced.

Continental Carbon – PHOENIX® Unit

Carbon filtration is extremely effective at removing hydrogen sulfide but is only capable of removing low levels of other odor causing constituents. Other sulfur compounds such as carbonyl sulfide, methanethiol (mercaptan), dimethyl disulfide, as well as organics such as ammonia will not be appreciably removed through carbon filtration.
While carbon filtration has a lower capital cost than alternative methods of odor treatment, the operation and maintenance costs associated with recharging the media are typically higher.

Chemisorptive Media Scrubbing

Similar to carbon adsorption, other dry media systems have been developed using combinations of carbon, alumina and other binders for the adsorption of H_2S and other sulfurous compounds. Unlike the PHOENIX® unit, the media within this system has a limited life and cannot be regenerated onsite. Purafil, a manufacturer of chemisorptive media, offers laboratory analysis of the media to determine remaining life. The spent media also meets normal landfill disposal requirements as it is within an acceptable pH range.

These systems are commonly implemented at lower air flow rates and used for discharges from pump stations and other remote locations due to replacement media costs. As such, this technology was eliminated from further consideration for odor control at the Authority's facility.

Biofilters have evolved over time and are available in several forms. Media is available in organic or inorganic forms. Inorganic synthetic media is newer to the market but well tested for performance. The benefit of the synthetic material is its resistance to compaction and degradation allowing greater media depths and less frequent replacement. While biofilters have the largest footprint of the technologies evaluated, the modular biofilter design with synthetic material has a smaller footprint than an open bed design with organic media.

Biofilters typically have a higher capital cost than carbon filtration, but a significantly lower operation and maintenance cost. The media which microbes grow on has service life estimated at 50+ years in some cases and would not require replacement during the unit's useful life. Additionally, biofilters require very little maintenance or oversight unlike carbon filtration and chemical scrubbing.

Two-Stage Biofiltration

The two-stage biofiltration system involves a biofilter followed by a carbon filter for polishing. The carbon system allows for treatment of peak H_2S concentrations or continuous treatment if the biological system is somehow upset. The two-stage system evaluated for the Authority's application is a modular unit manufactured by Evoqua. Evoqua uses a Bioglas media in the biofilter with a typical life of 5-10 years. The second stage carbon has an approximate life of 3-5 years.

Photoionization

Photoionization is an emerging odor treatment technology that utilizes physical and chemical processes as the treatment mechanism. UV light is applied to the air flow creating oxidizing agents such as oxygen, hydroxide, ozone and activated oxygen to oxidize and break down into non-odorous compounds. Odorous compounds not treated by the UV light are trapped and broken down through other reactions in the catalyst. For the Authority's application, the catalyst would be an impregnated activated carbon, but can vary based on the application and required clean air conditions.

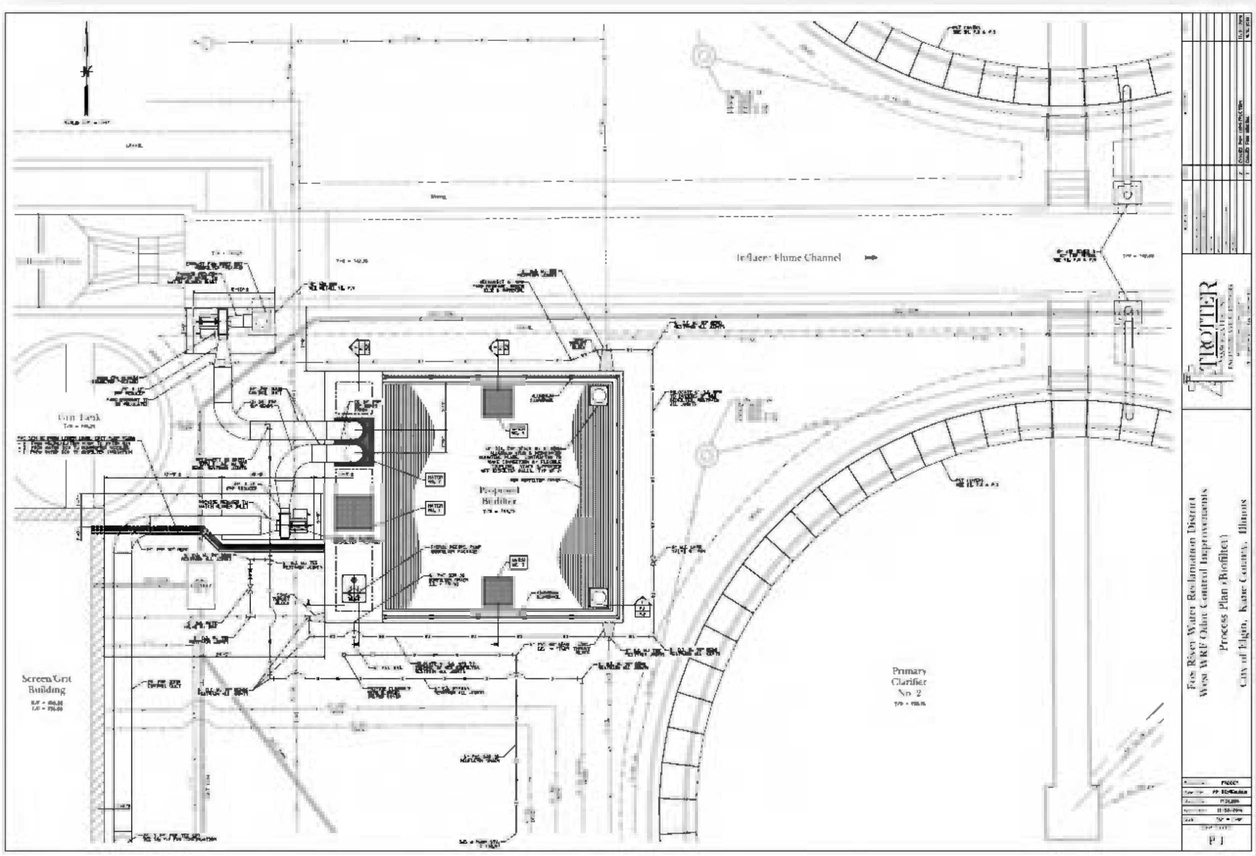
AMBIO – Photoionization Unit

The capital cost of the photoionization system is marginally less than a modular biofiltration unit with inorganic media. Photoionization units require a relatively small footprint but have a high maintenance cost due to replacement of the bulbs and catalyst material every 18 to 24 months. The operating cost is typically lower than alternative technologies and primarily consists of power associated with the UV system. While photoionization is relatively new to the United States odor control market, it has been in use primarily within Germany for over a decade. Further investigation would be required to determine whether this emerging technology represents a viable alternative for the Authority.

6.10 ODOR CONTROL TECHNOLOGY SELECTION

For the Grit Tanks and Primary Clarifier Launders, carbon adsorption (regenerating), biofiltration, two stage biofilter and photoionization are considered viable alternatives. Carbon adsorption is appropriate for this application, however the operation and maintenance costs of these systems make this a less desirable technology. Biofiltration is a suitable technology however requires a larger footprint and has a higher installation cost, but has the lowest operational cost. The two-stage biofiltration and photoionization systems have similar installed and operational costs to the carbon adsorption system. Biofiltration has proven effective in treating the moderate to high H_2S concentrations and H_2S-related odors in the PSTs. The H_2S concentrations in this area should be relatively consistent and all four technologies should perform similarly.

For the Gravity Thickener, all of the presented technologies, with the exception of chemical scrubbing, were considered suitable for treatment. Carbon adsorption (without regeneration) and chemisorptive processes are both applicable for small air flow rates and will be able to treat peak concentrations. The biological stage of the Evoqua unit typically removes 75% of the odorous VOCs and the carbon will remove the remainder. Overall, Evoqua reports 95% or better VOC removal and 99.9% H_2S removal in most applications. Photoionization technology has a similar carbon polishing stage that will also handle peak loading conditions.



Selection of the most applicable technology is dependent upon the air flow rate and the operator maintenance required to maintain the selected alternative. A general list of the advantages and disadvantages of each technology are included in Table 6-4 below. Since photoionization is an emerging technology for odor control applications, at this time, the Authority has decided that a more established technology with local installations is more suitable for their application.

Also include in the table below is an estimated capital cost for each of the viable alternatives. This capital cost includes 15% contingency and 15% for engineering/administration. Chemisorption has been omitted as a viable alternative due to the high air flow rate, and chemical scrubbing has been eliminated due to the hazardous materials handling required.

Table 6-4: Odor Control Technology Advantages & Disadvantages

Process	Advantage	Disadvantage	Estimated Capital Cost (5,000 CFM)
Adsorption	– Capable of treating peak concentrations – Low capital cost	– Media replacement required – High capital cost for >400 cfm units	$1.37M
Chemisorption	– Capable of treating peak concentrations – Low capital cost	– Media replacement required – Only applicable for low air flow applications	N/A
Biofiltration	– Longer media life between replacements (some medias have 50+ year service lives) – Low operational cost – Ease of operation	– Not appropriate for intermittent loading – High capital cost – Largest footprint	$1.50M
2-Stage Biofilter & Carbon	– Ability to treat peak concentrations, compared to biofiltration alone – Longer media life between replacements	– May require nutrient addition – High operating cost, compared to other technologies	$1.58M
Chemical Scrubbing	– High removal efficiencies documented	– Significant operational and maintenance attention – Chemical handling required	N/A
Photoionization	– Small footprint – Carbon polishing stage to treat peak conditions	– High operating cost, compared to other technologies – Emerging technology with limited to no local installations	$1.05M

6.11 ODOR CONTROL STRATEGY SUMMARY

The Authority's primary objective is to protect public health and preserve the environment. This is accomplished through preliminary, primary, secondary and tertiary of wastewater. Historically, the Authority has maintained a good working relationship with its neighbors, however in recent years has received an increasing number of complaints regarding odors. The Authority has been proactive with respect to implementation of odor control measures throughout the facility. The odor control systems currently in place include chemical addition, and atomization and vaporization of an odor neutralizing product.

The project team's work included site walkthroughs, an analysis of the existing process, review of complaint reports, and work sessions with plant staff to discuss the issues and current operational procedures. As a result, the project team and staff have identified areas where implementation of operational changes and best management practices can mitigate some of the odor complaints. Two areas of high priority that require further investigation and potentially capital improvements include the preliminary/primary treatment and sludge thickening processes.

It is recommended that the Authority determine whether any of the alternatives presented warrant further review, and if so these improvements should be incorporated into the 2018 10-Year Facility Planning document for implementation. The Authority should consider meeting with manufacturers of odor control technologies as a next step in this process.

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SECTION 7
REGULATORY REQUIREMENTS & BIOLOGICAL PROCESS

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7. Regulatory Requirements & Biological Process

7.1 General

According to the Illinois EPA Clean Water Act Section 303(d) List, the East Branch of the DuPage River does not meet water quality standards for its intended use in the majority of the segments, including the segments immediately downstream of the Glenbard Wastewater Treatment Facility. The East Branch DuPage River Segment GBL-10 is impaired for aquatic life based on poor vegetative cover, a low dissolved oxygen concentration, pH, chlorides, phosphorous, hexachlorobenzene, dieldrin, methoxychlor, and arsenic. Additionally, the GBL-10 receiving segment is impaired for fish consumption due to PCB's and primary contact due to fecal coliform. The next three segments downstream of the Authority's discharge (GBL-05, GBL-02 & GB-16) are impaired for aquatic life most commonly due to phosphorus, D.O., and TSS.

The IEPA attributes these impairments to a combination of agricultural runoff, municipal point source discharge, and crop production. The impairment for aquatic life is based on a low dissolved oxygen concentration. This low dissolved oxygen content is due to algal growth and exacerbated by the presence of pools upstream of the low head dams along the river. The increased algal growth can be attributed to elevated nutrient levels in the water. Phosphorus, a naturally occurring element, is the limiting nutrient in algal blooms. The increased dissolved phosphorus concentration is due to a combination of both non-point sources, such as agricultural runoff, and point sources, such as WWTP discharges.

In 2004, the Illinois EPA implemented statewide nutrient removal criteria for wastewater treatment facilities that were proposing expansion of their hydraulic capacity. Two nutrients of concern were total nitrogen and phosphorus. The NPDES Permits issued for these facilities typically contained an interim 1.0 mg/L monthly average phosphorus limit and requirement to monitor total nitrogen.

In 2005, many of the communities with the watershed (including the Glenbard Wastewater Authority) joined forces with other stakeholders, to form the DuPage River Salt Creek Work Group (DRSCW). This group was formed in response to concerns about the East and West Branch DuPage River TMDLs and Salt Creek TMDL. The goal is to better determine the stressors to the aquatic system though long-term water quality monitoring, and to develop and implement remediation projects. The DRSCW is working with the IEPA to issue NDPES permits that can attainably improve the water quality within the watershed.

In 2011, the Illinois EPA was receiving increased pressure by the USEPA and environmental stakeholders to address nutrient criteria on all POTWs, not only treatment plants undergoing expansion. Several NPDES permits along the DuPage River had expired and were due to be reissued by the Illinois EPA. However, the Illinois EPA elected to delay reissuance to gain concurrence on language to be included.

The Authority received a draft NPDES permit (No. IL0021547) in the summer of 2015. The permit established new regulations with which the Authority must comply. One of which is a 1.0 mg/L monthly average phosphorus limit, with a 10 or 11-year compliance period depending on the type of treatment constructed. The special conditions also included language that requires the submittal of a Feasibility Study to lower the annual average effluent phosphorus concentration to 1.0 mg/L, 0.5 mg/L and 0.1 mg/L.

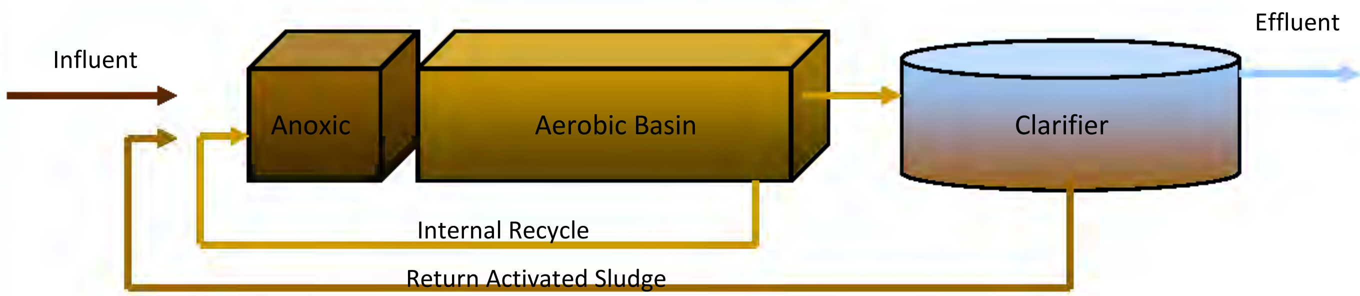
7.2 NITROGEN REMOVAL

Nitrogen in wastewater can be found in several forms including ammonia (NH_3), ammonium (NH_4^+), nitrate (NO_3^-) and nitrite (NO_2^-). In the past, limits were placed only on the levels of ammonia discharged from wastewater treatment facility since that is the only form of nitrogen that is toxic to aquatic life. Even though they do not directly harm fish, nitrates and nitrites can contribute to algal bloom because nitrogen is a nutrient used in algal growth. Phosphorus, in the form of phosphates (PO_4^-), can also trigger algal growth if it is present in high enough concentrations. Limiting phosphorus and total nitrogen, the sum of all forms of soluble nitrogen, helps to preserve ecosystems in the surrounding watershed.

The Authority is subject to anti-degradation requirements set forth Title 35 of the Illinois Administrative Code, Subtitle C section 302.105. The purpose of these regulations is "to protect existing uses of all waters of the State of Illinois, maintain the quality of water with quality that is better than water quality standards, and prevent unnecessary deterioration of water of the State." This will apply to the Authority if there is any future expansion and proposed pollutant loading increase. If this occurs, the Authority will need to modify this biological process to achieve total nitrogen removal. The removal of nitrogen is affected through the biological oxidation of nitrogen from ammonia to nitrate (nitrification), followed by denitrification, the reduction of nitrate to nitrogen gas. Nitrogen gas is released to the atmosphere and thus removed from the water.

The existing pure oxygen biological process was designed for conversion of soluble bio-degradable organic contaminants and nutrients, specifically ammonia nitrogen. Most aerobic biological processes are designed for the development of beneficial bacteria that are able to convert organic compounds and are capable of performing this task within a very short amount time. However, the conversion of ammonia nitrogen to nitrite (nitrification) is accomplished by Nitrosomonas bacteria. In order to develop and maintain a sufficient population of *Nitrosomonas* bacteria within the bio-mass, the process must maintain a low feed to mass ratio, with typical values ranging from 0.08 to 0.12.

Since the treatment facility cannot control the influent food source, operators control the bio-mass (MLSS) within the basins. There is a practical limit to the concentration of MLSS ranging from 2,000 to 3,000 mg/l. Therefore, the basins must be constructed large enough to allow the operators to develop a bio-mass population that is 10 to 12 times greater than the incoming food (soluble BOD). The operators maintain the ratio of food to mass by wasting the proper amount of solids from the process. The *Nitrosomonas* bacteria convert ammonia to nitrite, while *Nitrospira*, which are also present, convert the nitrite to nitrate.



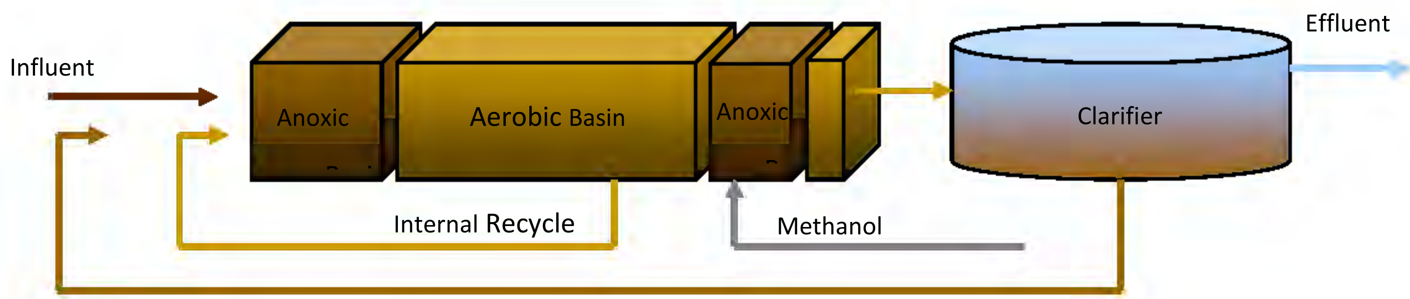
Denitrification is a biological process in which nitrite and nitrate, rather than oxygen, are converted into nitrogen gas in order to break down a food source. Denitrification is an alternative to respiration and is initiated by incorporating a zone that is rich in soluble BOD and operates at a dramatically low dissolved oxygen concentration, an anoxic zone. This zone is typically near the beginning of the biological process were the soluble BOD is plentiful. However, in order to convert the nitrate to nitrogen gas it must be first converted from ammonia to nitrate, which typically is near the end of the biological process. Therefore, most designs incorporate an internal loop, which brings the nitrate rich mixed liquor into contact with the high strength soluble organic matter.

The rate of flow of the internal recycle loop is a controlling factor in the efficiency of the nitrogen removal process. Simply stated, a recycle rate that equals the forward flow would equate to 50% removal, while a recycle rate that equates to twice the forward flow equates to 66% removal.

Recycle Rate = ($NH\text{-}N_{in}$ / $NO_3\text{-}N_{out}$) – 1 - Assuming 66% TKN Removal

Recycle Rate = (25 mg/l/ (25 x 0.34)) – 1 = 1.94 or 2

Since a future final effluent standard is unknown at this time, any design for the integrating denitrification should incorporate the flexibility to achieve 90% total nitrogen removal. This could be accomplished by incorporating a loop that equates to nine times forward flow, however this recycle rate requires a significant amount of horsepower and increases the overall detention time to maintain anoxic conditions. A more common alternative is a recycle rate of four times the forward flow and construction of a second phase which provides an auxiliary carbon source (typically methanol) for polishing. Due to the nature of the Authority's relatively unique pure oxygen process, incorporating a second phase would require conversion to a more traditional process-air based system due to oxygen saturation in the HPO system.



Traditional Two-Phase Denitrification Process Flow

7.3 Phosphorus Removal

Phosphorus can be present in wastewater in various forms. In order to efficiently remove it, it is important to understand in what forms it typically occurs. The phosphorus composition, or speciation, is site specific. Knowing this information from a wastewater sample allows for implementing the most efficient removal methods. In order to find this information, jar testing on wastewater samples is recommended during conceptual design of any phosphorus removal improvements. The Authority completed speciation, specifically to identify the soluble non-reactive (SNRP) fraction of the total phosphorus, as part of the 2017 Phosphorus Removal Feasibility Study.

Figure 7-1: Phosphorus Speciation Chart

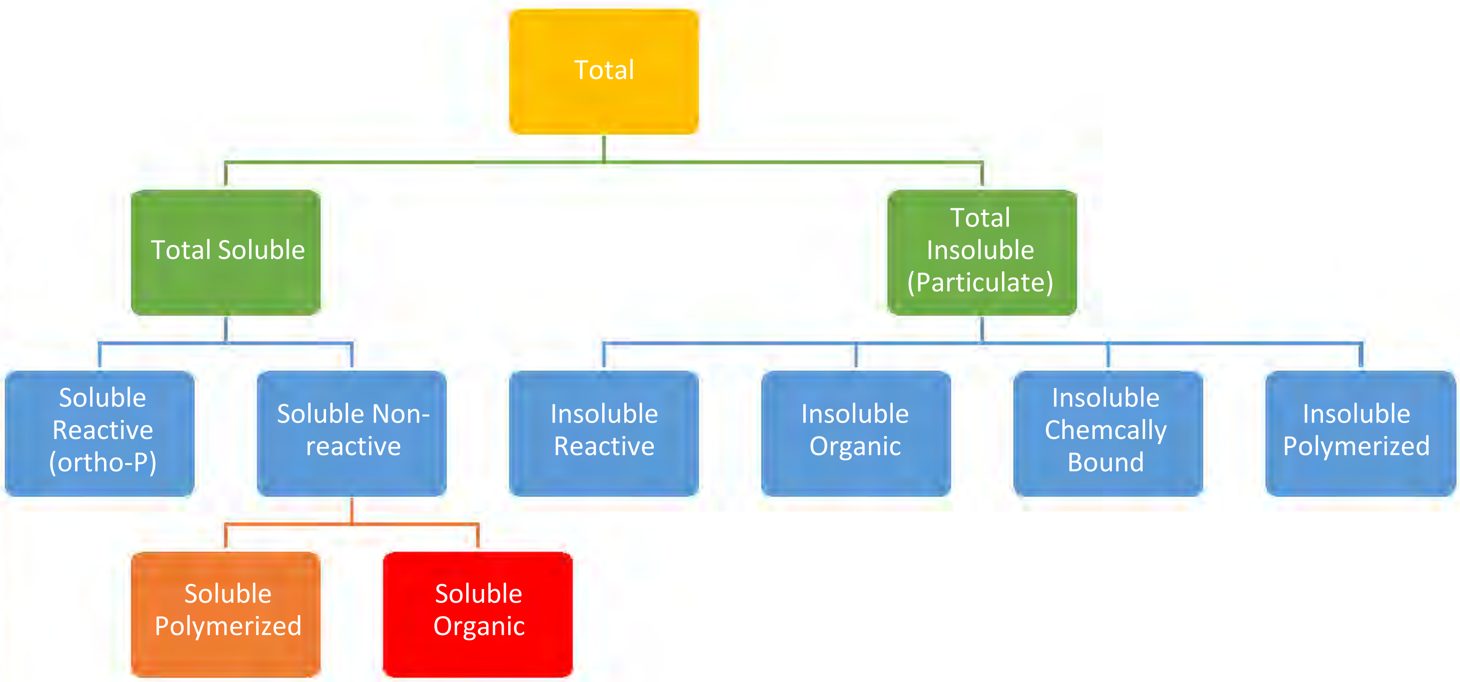


Figure 7-1 illustrates the various types of phosphorus that can be found in wastewater. Phosphorus removal can occur through either a chemical or biological process. In both processes, soluble phosphorus is converted to particulate phosphorus and removed through the waste sludge. Typically, only soluble reactive phosphorus (ortho-phosphorus or ortho-P) can be converted to the particulate form. It is possible to convert soluble polymerized phosphorus; however, this may take extensive time and resources.

Soluble organic phosphorus will not be converted and therefore cannot be removed from wastewater in typical processes. If extremely low phosphorus limits are implemented, advanced treatment technologies such as membranes or nanofiltration are required.

7.3.1 Chemical Phosphorus Removal Overview

Chemical precipitation of phosphorus can be accomplished within either the primary or secondary treatment process. The removal occurs through coagulation of soluble ortho-P from solution into a chemically bound particulate which coagulates into a solid and is removed via clarification or filtration. This solid can be removed in primary clarifiers with primary solids; it can be removed in secondary clarifiers as part of the mixed liquor (with the associated improved sludge settling properties); it can be removed in tertiary filters; or it can be removed in any combination of the three, with removal efficiencies generally increasing with the number of chemical addition points. Despite the widespread acceptance and use of this approach, the solid conversion mechanisms of orthophosphate have not been well understood and the success of chemical precipitation of phosphorus is highly dependent upon site specific conditions. As a result, it is important to conduct jar testing to determine the optimal chemical and dose of metal salt to be used for this process.

The Authority has several options for chemical selection. Lime addition is effective but produces a considerable amount of sludge. Aluminum sulfate (alum) and iron salts are more commonly recommended. Iron Salts are highly corrosive and should be stored in a separate, well-ventilated area. Aluminum sulfate is less corrosive and typically easier to handle. It is also locally available. The chemical precipitation of phosphorus is a complex chemical reaction with many competing reactions. The general simplified and unbalanced chemical equation for both alum and ferric chloride are:

$$Al^{3+} + H_nPO_4^{3-n} \rightarrow AlPO_4 + nH^+$$

$$0.8Al^{3+} + HPO_4^{-} + 1.4OH^- \rightarrow Al_{0.8}H_2PO_4OH_{1.4}$$

$$Fe^{3+} + H_nPO_4^{3-n} \rightarrow FePO_4 + nH^+$$

$$1.6Fe^{3+} + HPO_4^{-} + 3.8OH^- \rightarrow Fe_{1.6}H_2PO_4OH_{3.8}$$

According to Wastewater Engineering: Treatment and Resource Recovery (Metcalf and Eddy, 5th Edition) the metal salt ion will typically bond with hydroxide (OH) ions in the water before they bond with orthophosphate at pH's greater than 3.5. After this occurs, the metal hydroxide ion will bond with the orthophosphate ion (PO_4). Therefore, the concentration of either $Al_{0.8}H_2PO_4OH_{1.4}$ or $Fe_{1.6}H_2PO_4OH_{3.8}$ will be much higher than the concentration of $Al/FePO_4$ in the solids. From this, a mole : mole ratio of metal salt was derived for calculating how much chemical would be needed for precipitation of a known amount of phosphorus. Additionally, this ratio increases exponentially as target phosphorus levels extend below 1.0 mg/L due to competing reactions, solubility factors and pH issues.

For purposes of this report, alum was considered for volume and cost estimations. Alum was selected due to its efficiency, handling procedures, and reduced impact on downstream processes (specifically the UV system that the Authority utilizes).

The following equation was utilized to estimate the chemical demand:

$$Al_{dose} = \left(\frac{Al}{P}\right) * (C_{p,in} - C_{p,out})[26.98\frac{g}{mole\ Al}/30.97\frac{g}{mole\ P}]$$

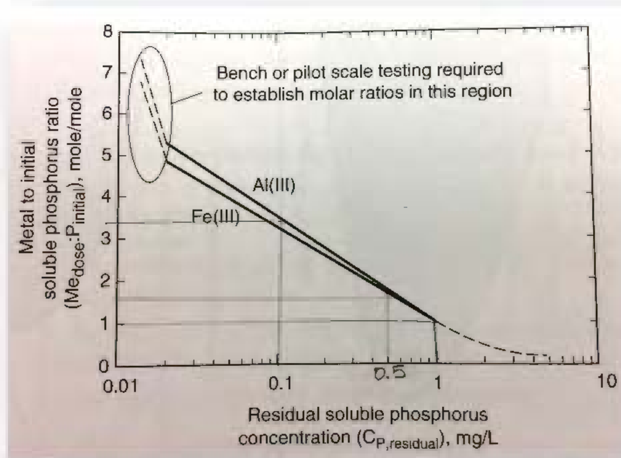
Where:

$C_{p,in}$ = influent phosphorus concentration

$C_{p,out}$ = residual phosphorus concentration

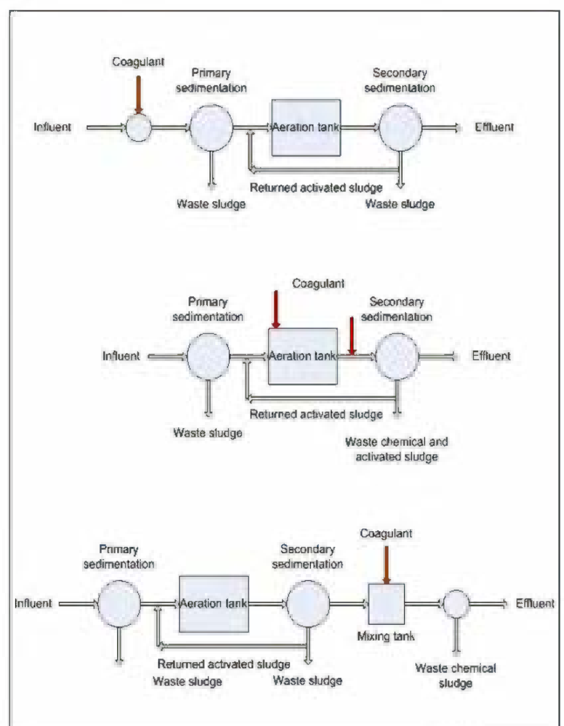
The (Al/P) ratio is determined by Figure 3 from page 484 of Wastewater Engineering (Metcalf and Eddy 5th Edition) based on the desired residual phosphorus concentration. For this report a molar ratio of 1.0 was utilized for 1.0 mg/L and 1.75 was used for 0.5 mg/L. The true molar ratio is suggested to be verified by jar testing during the preliminary design phase.

Figure 7-2: Molar Ratio Graph for Metal Salt



Chemical can be dosed at various locations throughout the treatment process, but each location has different benefits and drawbacks. It is typically estimated that the sludge production from chemical precipitation in the primary clarifiers will yield four times the influent pounds of phosphorus removed, which would increase overall primary sludge production by roughly 50%. Other more conservative estimates indicate sludge yields increasing by 100%. The actual yield should be field verified. Benefits of adding iron salt or alum to the primary clarifiers include increased efficiency in solids and BOD_5 removal and precipitation of copper ions.

Figure 7-3: Typical Chemical Dosing Locations



Chemical precipitation within the secondary process is slightly more predictable. Application points vary from site to site. Some facilities introduce the chemical to the RAS prior to entering the basins, while others add the iron salt or alum in the MLSS diversion structure. Advantages of precipitation in the secondary process include lower chemical requirements, increased settling ability of the flocs within the clarifiers, and lower sludge production. However, the sludge produced is a waste activated sludge and can reduce the efficiency of the anaerobic digestion system. When lower TP levels (<0.5 mg/L) are required, a multi-dose system can be used to maintain the molar ratio on the front end of the process reducing the chemical usage.

The average influent phosphorus concentration to the GAWTF is approximately 5.68 mg/L, based on January 2013 through December 2018 data. The chemical precipitation required for phosphorus removal is estimated to be 1.6 moles of iron (Fe) for 1.0 mole phosphorus (P) or 0.8 mole aluminum (Al) for 1.0 mole of P when effluent concentration is >2 mg/L. However, an additional one to five moles of metal salt is required to satisfy competing reactions, such as hydroxide formation at lower effluent levels.

The chemical dosing required should be verified through jar testing during preliminary design for any type of phosphorus removal systems as the recommendations presented in this study are conceptual based only.

The following information was used to calculate chemical dosing requirements of aluminum sulfate.

Molecular Weight of PO_4-P = 30.97 g/mole

Moles / Pound of PO_4-P = 453 g/lb. / (30.97 g/mole) = 14.6 moles of PO_4-P / pound

Molecular Weight of $Al_2(SO_4)_3*14H_2O$= 594 g/mole

Molecular Weight $Al_2(SO_4)_3*14H_2O$ -Al = 27 g/mole

Moles / Pound of $Al_2(SO_4)_3*14H_2O$-Al = (453 g/lb. / 27 g/mole Al)

= 16.8 moles of Al / pound

Pounds of $Al_2(SO_4)_3*14H_2O$ per gal of solution

= 11.11 lb. / gal x 49% = 5.44 lbs. of $Al_2(SO_4)_3*14H_2O$ / gallon

(5.44 lb $Al_2(SO_4)_3*14H_2O$ / gallon) x (27 g/mole / 594 g/mole) x (2 mole Al / mol $Al_2(SO_4)_3*14H_2O$)

= 0.49 lbs. of $Al_2(SO_4)_3*14H_2O$ – Al / gallon

(0.49 lbs. of $Al_2(SO_4)_3*14H_2O$ - Al / gal) x (16.8 moles / pound)

= 8.3 moles of $Al_2(SO_4)_3*14H_2O$ - Al / gallon

In order to achieve effluent TP levels of 1 mg/L a molar ratio of 1 mole Al : 1 mole P was used.

In order to achieve effluent TP levels of 0.5 mg/L a molar ratio of 1.75 mole Al : 1 mole P was used.

In order to achieve effluent TP levels of 0.1 mg/L a molar ratio of 3.5 mole Al : 1 mole P was used.

Chemical Alternatives

There are a variety of chemicals available for use in chemical phosphorus removal, each with characteristics that must be considered with plant specific parameters to determine the best choice in chemical. The three chemicals that were evaluated for the purposes of this study were metal salts (ferric chloride and aluminum sulfate) and rare earth metals (RE-300 by Neo Performance Materials, formerly known as SorbX-100).

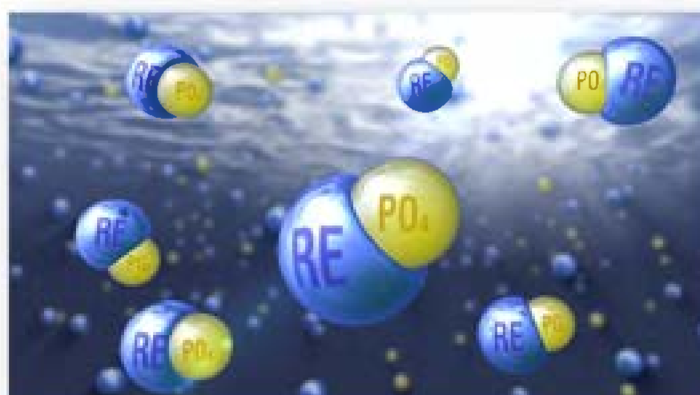
Metal Salt and Alternative Chemicals

There are several metals salts that have been proven to be effective for phosphorus removal in domestic wastewater. It is important to note that the selection of which metal salt will best suit the need of the user is project specific with great importance given to the operation cost of the selected salt. There are also other important non-economic considerations including:

- Metal salt handling hazards
- Commonality with other plant or Utility processes
- Storage requirements for winter temperatures
- Metal salts shelf life
- Impact to plant's processes

The most commonly used metals salts for phosphorus removal are ferric chloride and aluminum sulfate, as they have proven to be the most cost beneficial alternatives for most plants as a starting point. Additional chemicals are available including sodium aluminate, and RE-300 (a rare earth metal).

Ferric chloride is extremely corrosive and hazardous to work with. There are many safety measures that must be taken into account if this chemical is selected. Aluminum sulfate is less corrosive and typically easier to manage. Sodium aluminate is another aluminum-based chemical that is typically more expensive but does not consume alkalinity, so it may be cost effective if alkalinity becomes an issue.



RE-300 is a rare earth metal manufactured by Neo Performance Materials that is used for phosphorus removal. It is significantly more expensive, but also much more efficient for phosphorus removal. It also can withstand any environment down to -400°C, and therefore would not need to be contained within a building to prevent freezing. This leads to lower initial capital costs. RE-300 is also worthy of consideration when sludge volume is an issue, as it does not increase the sludge accumulation to the same magnitude as both Alum and Ferric. Jar testing or bench testing will help to determine which of these chemicals would be the most cost effective for the specific conditions found at the GWA facility.

Jar Testing Procedures

In order to evaluate the potential for chemical phosphorus removal, it is recommended that jar testing be performed prior to entering preliminary design of any phosphorus removal improvements at the plant. Based on data provided in previous nutrient removal studies (2013 Facility Plan and 2017 Phosphorus Studies) it appears the Authority's facility correlates well with other plants in the region. Therefore, standard chemical precipitation characteristics were utilized for the purposes of this report rather than performing jar testing at this stage. In the future, it is recommended that the Authority perform jar testing prior to entering design of any upgrades. Jar testing results can be used to:

- Confirm the amount of chemical necessary in order to optimize phosphorus removal.
- Confirm the solids production resulting from precipitation of phosphorus.
- Determine the soluble non-reactive fraction of phosphorus in the plant's process flow.
- Determine the impacts of metal salts on UV transmittance.

A sample jar testing protocol is included within the appendix of this study. It is important to note that this jar testing protocol has not been designed to evaluate mixing kinetics as they relate to phosphorus removal at the facility. It is recommended that mixing is evaluated during the conceptual design phase of the phosphorus removal implementation because in poorly mixed systems phosphorus removal can be decreased as much as 25% compared to well-mixed systems (Smith et al., 2008). Clearly, this factor has an impact on both chemical costs, and sludge production and handling. For purposes of this study, the well accepted typical phosphorus breakdown for standard domestic wastewater was considered.

Addition of metal salts for chemical precipitation can consume alkalinity and depress the solution pH. The NPDES permit limit on pH is between 6.0 and 9.0. During wastewater treatment using activated sludge processes, substantial alkalinity can be consumed during nitrification and alkalinity can remain low if a denitrification process does not recover adequate alkalinity. Therefore, both pH and alkalinity should be measured in the laboratory.

The Authority utilizes ultraviolet disinfection for effluent treatment, and as such it is important to understand if the process used for phosphorus removal could have potential impacts on these systems. It is widely known that the chemical precipitation process used to remove phosphorus from wastewater effluent can also impact the color, organic carbon, and total suspended solids in effluent; TSS and UVT samples should be submitted for laboratory analysis to evaluate the impact of this process on these indicator parameters. Conversely, residual iron from ferric coagulants may adversely impact UV performance because of increased inorganic fouling of quartz sleeves, which is also a function of hardness in the effluent. Additionally, because UV disinfection inactivates microorganisms at specific UV wavelengths, residual iron can have a negative impact on the transmittance of UV through wastewater. These issues are typically associated with ferric iron, although ferrous iron can also have an impact; impact threshold concentrations, which are concentrations that result in UVT decreases from 91 to 90 percent, have been reported at 0.057 mg/L for ferric iron (Fe_{3+}) and 9.6 mg/L for ferrous iron (Fe_{2+}) (Bolton et al. 2001). Thus, residual dissolved iron concentrations would need to be evaluated during jar testing.

7.3.2 Biological Phosphorus Removal Overview

All life forms utilize a food source and a source of oxidative potential, usually oxygen or nitrite, to absorb phosphates into their bodies as the molecule adenosine tri-phosphate (ATP). This process is known as metabolism. Phosphorus is released from ATP to provide energy for cellular growth and activities. When activated sludge is produced and collected, phosphates absorbed within the cells of microorganisms as ATP and other cellular components are removed from the wastewater flow. This is the basis for biological phosphorus removal, a small amount of which occurs in all activated sludge processes in which activated sludge is wasted. In biological nutrient removal, soluble ortho-P is converted to organic particulate phosphorus and removed with the sludge.

Greater amounts of phosphorus can be removed through biological methods by creating an anaerobic zone, in which no oxygen or nitrate is available, within a treatment facility's suspended biological growth processes. Most heterotrophic and autotrophic microorganisms are not capable of storing large amounts of ATP and rely on a constant rate of metabolism to maintain cellular activity. Certain heterotrophic microorganisms known as Phosphorus Accumulating Organisms (PA/Os) can store significantly more phosphorus than other heterotrophic bacteria. PA/Os are capable of metabolizing organic matter in an anaerobic environment absent of nitrate and oxygen. As such, the percentage of PA/Os within the microbiological community increases when the process includes an anaerobic zone. The larger PA/O population ensures a higher concentration of phosphorus within the sludge wasted from the process.

Biological Phosphorus Removal (BPR) requires rigid operational control in order to maximize the efficiency of the process. The process is sensitive to changes in temperature, flow and feed concentration. BPR may not be able to continuously meet the 1.0 mg/L effluent standard set by the IEPA. Therefore, chemical polishing capabilities would be incorporated into any biological phosphorus removal design.

It is important to note that the phosphorus captured in the BPR process is simply stored in the bodies of microorganisms and can easily be returned to solution. The high phosphorus sludge is wasted from the biological process to a sludge stabilization process. Once stabilized, the sludge is then dewatered and disposed of through land application or land filling operations.

The existing biological process may be modified to reduce the concentration of phosphorus for the new NPDES permit limit. Consideration also must be given for the biological reduction of nitrogen for possible future limits. This approach to wastewater treatment is called Biological Nutrient Removal (BNR).

It has been documented that anaerobic zones are needed to provide an environment where the PA/Os are allowed to metabolize influent organic material with limited competition from other organisms. In this environment, the PA/Os release phosphorus and metabolize the readily biodegradable Chemical Oxygen Demand (rbCOD). In downstream aerobic zones, the PA/Os enter an endogenous state and perform luxury uptake of phosphorus. The following excerpt from the 4th Edition of Wastewater Engineering: Treatment and Reuse (Metcalf and Eddy) further explains the zones within a typical Biological Phosphorus Removal (BPR) system:

"Wastewater characterization, including rbCOD measurements, is essential to evaluate fully the design and performance of BPR systems. Biological phosphorus removal is initiated in the anaerobic zone where acetate (and propionate) is taken up by phosphorus-storing bacteria and converted to carbon storage products that provide energy and growth in the subsequent anoxic and aerobic zones. The rbCOD is the primary source of volatile fatty acids (VFAs) for the phosphorus-storing bacteria … The more acetate, the more cell growth, and, thus, more phosphorus removal."

Raw wastewater is anaerobic and therefore the majority of nitrogen is in the form of ammonia (NH3). The nitrogen cycle includes four forms; ammonia → nitrite → nitrate → nitrogen gas. Ammonia, nitrite and nitrate are all soluble, whereas nitrogen gas is released to the atmosphere. Therefore, removal of nitrogen from wastewater requires a process which produces nitrogen gas. Nitrification is an aerobic process where organisms oxidize ammonia to nitrite and nitrate. Nitrosomonas and similar microorganisms oxidize ammonia (NH3) to nitrite (NO2). Nitrite is oxidized to nitrate (NO3) by Nitrobacter and similar microorganisms. Denitrification is an anoxic process where organisms convert nitrate to nitrogen gas (N2). The driving mechanism for denitrification is the microorganisms need to obtain the oxygen molecule for respiration. Under anoxic conditions, the oxygen molecule from the nitrate is utilized as an oxidation source. This process is more efficient when microorganisms have a readily available carbon source. Typically, this reaction competes with phosphorus removal. Large nitrate loading to the anaerobic process can inhibit phosphorus removal. Therefore, to achieve biological nutrient removal, anaerobic and anoxic zones are required.

The alternation from anaerobic, anoxic and aerobic zones have been modified, enhanced and utilized in several different configurations. As the influent to each wastewater treatment facility and the desired effluent quality is different, the configuration of BPR or BNR processes must be carefully evaluated.

BOD/TP Ratio

The BOD/TP ratio in the influent to the biological process is an indicator of how effective biological phosphorus removal will be. For example, it is preferred that this ratio be greater than 20 for moderate to high efficiency of the biological phosphorus removal process. Values of less than 20 indicate that the process may have low efficiency. The results from the BOD and TP analysis indicate that the BOD/TP ratio in the primary effluent (entering the biological process) is in the range of 8.8. This suggests that operation of a biological phosphorus removal process would require significant augmentation with a viable source of supplemental BOD.

Additionally, nitrogen compounds will typically take up the available rbCOD (readily biodegradable COD) prior to the PA/Os. Therefore, due to the higher ammonia loading to the facility, a BNR design would need to incorporate some form of supplemental BOD, preferably rbCOD, to ensure that the process is effective and meets the Authority's effluent TP limits. There are several methods of providing supplemental BOD that should be considered for implementation of biological phosphorus removal at the WWTF.

The solids removed from process flow in the primary clarifiers could be conveyed to a mixed primary sludge fermenter. In this process, the supernatant would provide a supplemental source of BOD to either the primary clarifier influent or directly to the biological process while the thickened sludge from the bottom of the fermenter would be sent to the anaerobic digestion system. In the fermenter supernatant, the BOD would be in the form of Volatile Fatty Acids (VFAs). Considerations for ragging and grit build-up within the primary sludge fermenter must be considered in the design. Other design considerations should include the high-torque mechanisms required by the deep sludge blankets, odor control and mixing within the fermenter. Due to the abnormally low rbCOD to the GAWTF fermentation alone may not reliably provide the requisite carbon.

Research has shown a release of 1.0 mg/L TP for every 2.0 mg/L acetate as COD removed anaerobically (Ekama et. al., 1984). While acetate is naturally present in the raw influent, the dilution of this constituent during peak flows and wet weather events will likely require a supplemental source if this is to be utilized as a carbon source. The Authority could purchase a supplemental carbon source such as acetate and install a feed system to dose the primary effluent and maintain a stable BPR process. Brands such as MicroC™ specialize in bio-augmentation for nutrient removal if an acetate feed is selected. The cost of MicroC™ bulk delivery to Glen Ellyn, IL is about $1.80/gallon. One gallon of MicroC™ equates to about 9.2 lbs of readily biodegradable COD. Alkalinity can be an issue with MicroC™.

Impact of Bio-P on Anaerobic Digestion and Compounding Phosphorus

Implementation of a BNR process must consider effects on downstream processes. Orthophosphate tied up in PA/Os from the BNR process is released under anaerobic conditions. The Authority's sludge stabilization process is anaerobic digestion, after which the sludge is dewatered with belt filter presses. The recycle stream from the dewatering process, called filtrate, is made up of the water that is separated from the sludge as it goes from about 2% solids to 16% solids. Operation of a BNR process will cause the filtrate to have elevated concentrations of soluble phosphorus. This is due to the release of phosphorus from the solids during the anaerobic digestion process from the anaerobic conditions, as well as from solids destruction where phosphorus was previously stored. This leads to issues when filtrate is recycled back to the head of the plant. One area of concern is the potential for struvite formation.

Struvite is a compound made up of magnesium, ammonium and phosphorus. Alkaline conditions increase the potential for struvite crystallization, which can attach to the mixing systems, heat exchangers, sludge recirculation pumps and sludge transfer pipes. Struvite may be controlled by minimizing the concentrations of the three main soluble ions (Mg, NH_3, and P) or chemical addition to maintain a low pH level.

High soluble phosphorus levels in the filtrate could create progressively greater soluble phosphorus loading to the Wastewater Treatment Facility. It is projected that loading may increase by as much as 100%. Without addressing this concern, phosphorus levels in the effluent would continue to increase and the biological process could become carbon-limited. This issue may also be addressed by dosing the digested sludge with a metal salt prior to dewatering or by implementing a phosphorus reducing form of sidestream treatment. Section 7.4 provides a discussion of various methods that will address mitigation strategies for potential struvite formation and phosphorus overload to the biological process.

Biological Process Alternatives

A/O Process

The A/O configuration of the biological process is named for its anaerobic and aerobic ("oxic") zones. This is a biological phosphorus removal (BPR) process, meaning it only addresses phosphorus removal. It is a single-stage suspended growth system that combines anaerobic and aerobic sections in sequence. It is used for combined carbon oxidation and phosphorus removal. In the anaerobic stage of this process, phosphorus is released from wastewater and recycled cell mass into soluble phosphates. Additionally, the percentage of PA/Os in the water increases. When moved into the aerobic basin, the PA/Os take up the phosphorus. The reduction in phosphorus concentration is directly correlated to the BOD/TP ratio. When the ratio of BOD/TP is greater than 10:1, typically effluent concentrations of soluble phosphorus can be lower than 2 mg/L. However, this ratio is impacted by competing reactions due to nitrates in the process.

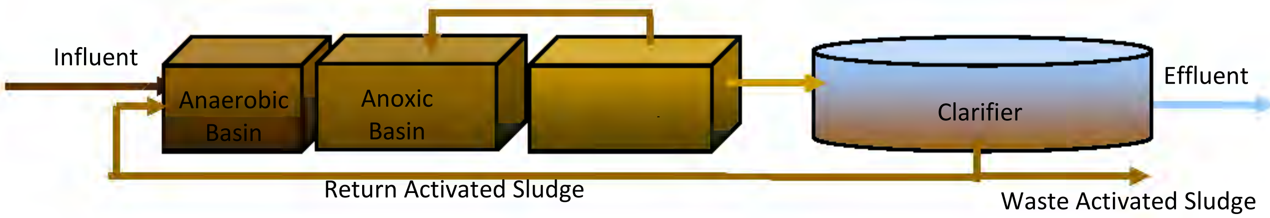
At the GWA, conversion to an A/O process, or any biological phosphorus removal process, would require significant modifications. Due to the oxygen saturation of the high-purity oxygen system, bio-p would require conversion to a more traditional process-air system. This would entail removal of the Unox deck, mixers, intermediate clarifiers, intermediate pump station, carbo RAS/WAS, and the installation of diffused aeration systems with low-pressure air blowers. Additionally, significant retention time would need to be added to the system. Single-stage nitrification typically requires a minimum of eight hours aerobic HRT – the GAWTF currently has approximately 4.4 hours total between the two existing stages.

Following conversion to diffused aeration, the A/O process could be created by installing a baffle wall in the aeration basins to create an anaerobic zone with an HRT of 1.5-2 hours (about 556,000 gal) and maintain aeration in the remaining tankage. Typically, an anaerobic zone with an HRT greater than 2 hours is not installed due to issues with odor and filamentous material. Additionally, the aerobic zone should be maximized to preserve the nitrification process.

In order to provide the recommended 1.5-2.0 hours anaerobic HRT and 8.0 hours aerobic HRT, approximately 3.75 MG of additional aeration basin capacity would be required. This would necessitate extension of the existing basins approximately 165 ft to the east with the same basin width of 20 ft and sidewater depth of 14.9 ft. This extension would put the eastern edge of the basins in close proximity to the final clarifiers and may require construction of additional tankage to the north (existing carbo RAS station). The costs associated with the conversion to single-stage nitrification are discussed further in Section 7.6.

A2/O Process

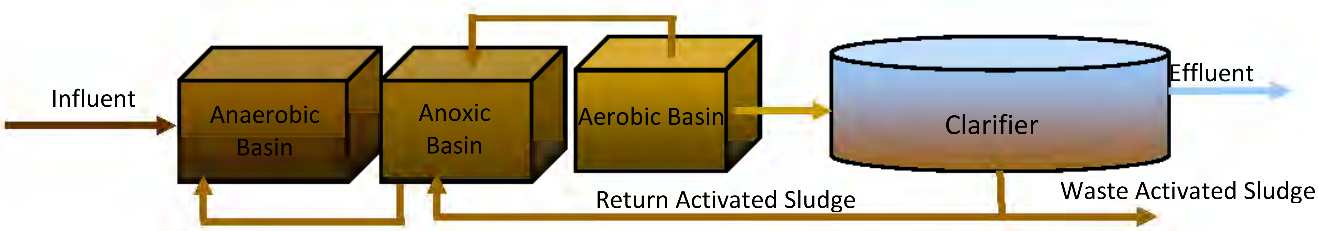
The A2/O configuration of the biological process utilizes three zones. It is a modification of the A/O process that provides an additional zone which is anoxic, allowing for denitrification. This zone has low dissolved oxygen but is high in oxygen which is chemically bound in the form of nitrate or nitrite. This zone is created by recycling nitrified mixed liquor from the aerobic section back to a basin which is not aerated. The head of the process is the anaerobic zone, followed by the anoxic and the aerobic zone. The internal recycle of approximately 2-4 times the design flow from the end of the aerobic zone is conveyed to the head of the anoxic zone. This internal recycle will denitrify approximately 66% of the flow. A2/O typically reduces phosphorus levels to less than 2 mg/L, with even lower concentrations if the effluent is filtered.



Modified UCT Process

The UCT process, developed at the University of Cape Town, is similar to the A2/O process. There are two distinguishing factors in this process; the return activated sludge is recycled to the anoxic stage, and there is an internal recycle from the anoxic zone to the anaerobic zone. Doing this eliminates nitrate in the anaerobic zone which improves the release of phosphorus.

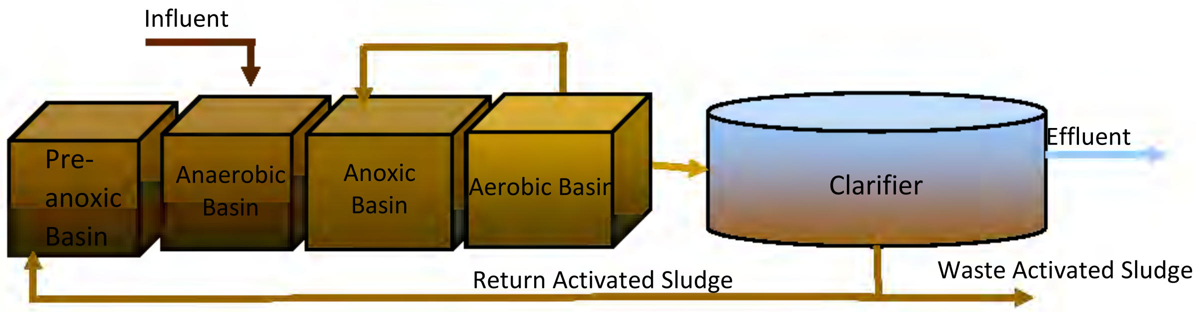
Additionally, the internal recycle provides for increased organic utilization in the anaerobic zone. The mixed liquor from the anoxic stage contains very little nitrate but significant soluble BOD, making it optimal conditions for fermentation. This releases volatile fatty acids, increasing the concentration of rbCOD, the main food source for the microorganisms.



This process would be the most complex to implement at the GAWTF due to the location where the RAS is introduced to the biological process. This would require rerouting the RAS from the sludge pump station to the anoxic basin where diffusers would be used to disperse RAS within the basin.

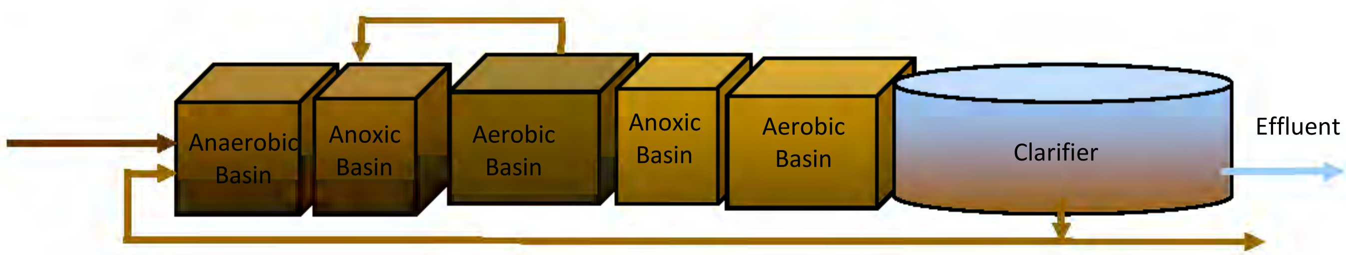
Johannesburg Process

An alternative process to UCT is the Johannesburg process. This originated in Johannesburg, South Africa and provides a slightly different configuration to the biological process. The process utilizes four different zones; pre-anoxic, anaerobic, anoxic, and aerobic.



The pre-anoxic zone is designed to denitrify the RAS to minimize nitrate interference in the downstream anaerobic process. Influent is introduced to the second basin after RAS has already been internally recycled and denitrified. The layout for this process would be similar to that of the UCT, however an additional basin would be required (the pre-anoxic). The recycle would need to be re-routed to this new basin. Preliminary calculations show this model may be less effective than both the A2/O and UCT and would be significantly costlier due to the increase in piping upstream of the biological process.

Five-Stage Bardenpho Process



Originally developed by Dr. James Barnard, this configuration provides denitrification and phosphorus removal, which is the basis for the name of the process (Bar-den-pho). The head of the process is an anaerobic zone, followed by the first set of anoxic and aerobic zones. An internal recycle of approximately four times the design flow from the end of the first aerobic zone is conveyed to the head of the first anoxic zone. This internal recycle will denitrify approximately 80% of the flow. The configuration ends with a second set of anoxic and aerobic zones. The second anoxic zones provide additional denitrification by utilizing nitrate from the first aerobic zones in combination with the organic carbon to create nitrogen gas, which is stripped from the water in the final aerobic zone. The typical Five-stage Bardenpho process requires approximately 14 hours of hydraulic retention. This process typically does not improve phosphorus removal, but it does lower TN. This could easily be adapted from the A2/O process if stricter TN limits are implemented. It would be costly to implement due to the need for additional tanks and should only be considered if strict TN limits are enforced.

7.3.3 Additional Solids Handling Considerations

For proper comparison of phosphorus removal alternatives, the impact on the solids handling operations of the GAWTF must be considered. The increase in sludge for chemical phosphorus removal would be determined based on the dosage of chemical required for various limits with the assumption that 100% of the chemical that is added would be removed with the solids, as well as the increase of solid phosphorus that would be removed with the sludge. The increase in sludge for biological phosphorus removal would be determined based on assuming an increased yield in the biological process due to increased solids production by the biomass.

The subsequent solids handling processes would also be marginally affected (digester loading would increase, digested sludge storage would decrease, required hours of belt press dewatering operations would increase, etc.). The chemical vs. biological phosphorus removal alternatives may produce similar quantities of sludge for 1.0 mg./L. The impact of chemical is seen at lower limits, especially when 0.1 mg/L is considered. There are also non-economic impacts to be considered include potential for struvite formation within the digesters and the ability to dewater the digested sludge.

Increased available phosphorus may result in the formation of additional struvite in plants that employ anaerobic digestion. The existing biological process removes roughly 40% of the influent phosphorus. The previously discussed phosphorus removal processes would need to increase this to 82% to obtain 1.0 mg/L effluent phosphorus. The use of metal salts for chemical polishing should reduce the potential for struvite production by tying up the phosphorus in the digesters. This will eliminate the need for an additional chemical buffering system to mitigate any struvite build-up. Typically a weak acid is used to regulate the pH of the sludge between 6.5 and 7.5, increasing the solubility of the chemicals that would form struvite in solution if the pH drops. Alum or ferric chloride would both fit this criteria.

This increase in sludge production from either chemical or biological phosphorus removal should be taken into consideration during conceptual design of any dewatering improvements. The additional sludge production may be mitigated in biosolids hauling by implementing a more effective dewatering technology – centrifuges for example. The anticipated increase of 35-40% in cake solids (16% to +/- 22%) would result in less overall biosolids production from the sludge stabilization and dewatering processes.

7.4 SIDESTREAM TREATMENT

Consideration must be given to the fact that much of the nutrient loading to the biological process comes from the addition of recycle flows from the filtrate after dewatering. In conventional wastewater treatment plants, WAS is the main phosphate carrier. In Bio-P plants with anaerobic digestion, there is a large amount of internal phosphate recycling through the sidestream from the dewatering processes. At the Authority, filtrate from the centrifuges is recycled to the head of the process. Anaerobic digestion of solids from a BNR process would re-release phosphorus into its soluble form and then separate it from the solids in the belt presses. This would lead to high phosphorus concentration in the recycle.

Additionally, ammonia is concentrated in the filtrate, increasing the nitrogen loading to the biological process. This can negatively affect BNR processes due to competition for carbon sources. The filtrate is returned to the head of the biological treatment process and continues to compound through the processes. It was determined that high nutrient loading in the filtrate at both current and design conditions would likely hinder the BNR processes. By removing this side stream, the BNR processes discussed previously could reduce phosphorus levels significantly lower. There are various side stream treatment methods that can nearly eliminate either phosphorus or ammonia from the filtrate.

Treatment of the sidestream flows is a direct method of decreasing the nutrient loading to the biological process. For the Authority, the filtrate from dewatering likely contains the highest concentration of both ammonia and phosphorus being returned to the liquid process stream. The high ammonia loading limits the BNR capabilities and the additional phosphorus loading reduces the Bio-P efficiency. Therefore, direct treatment of the filtrate should be considered. Sidestream treatment can consist of phosphate reduction, ammonia reduction, or both. It was found that removing the phosphate alone from the centrate could reduce phosphorus concentration in the effluent by an average of 80-90% under design conditions for similar facilities. The removal of TKN (the majority of which is ammonia, NH_3) only reduces the effluent P concentrations by 40-50% at design conditions. If both phosphate and TKN were removed, the effluent P would be reduced by 85+% under design conditions.

It should be noted that in order for the sidestream technology to function properly, a Bio-P process must be present within the treatment process to provide enough phosphate to the sidestream. The following sections outline alternatives that are being considered for phosphate recycle reduction at the WSD.

7.4.1 Phosphate Reducing Sidestream Treatment

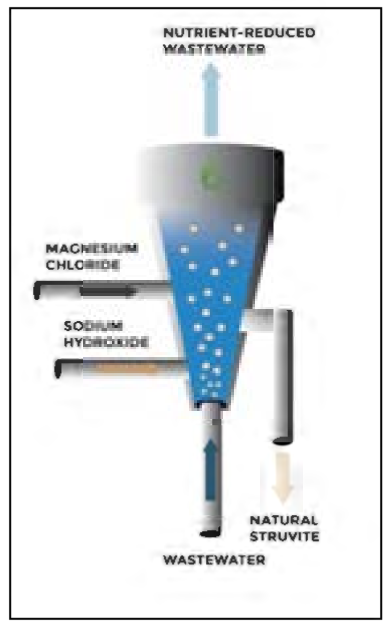
One method of reducing the phosphorus in the sidestream, reducing nutrient load to the biological process as well as struvite production potential, is dosing metal salts to prior to the anaerobic digestion process. This would chemically bind the phosphorus that is re-released in the soluble form under anaerobic conditions, causing it to be removed with the dewatered sludge rather than recycled. The methods described in the following sections are also available. They are typically more costly from a capital standpoint, however should be considered for reasons such as potential for payback as well as environmental stewardship. The methods presented in this section are alternatives that could be used rather than chemical dosing.

Reduced Anaerobic Digestion Retention Time

One way to reduce the nutrient loading in the side stream is by minimizing the hydraulic retention time (HRT) in the anaerobic digester. The longer the sludge is exposed to anaerobic conditions, the greater the re-release of phosphorus to soluble-P will be. The HRT could be minimized by increasing the wasting rate of the WAS or primary sludge. It is important to recognize that this will be a balancing act between maintaining the VSS destruction and methanogenesis process and reducing phosphorus re-release to the liquid stream. In order to meet permit limits and produce adequate biogas to feed to the burners for maintaining heat in the digesters, a sufficient HRT is necessary. Currently, the HRT is much longer than what would be required to meet Part 503 pollutant limits and could be reduced. This will not eliminate the need for other sidestream treatment, but could reduce the chemical required if chemical dosing is selected for sidestream nutrient management. This would simply be an operational change that would not result in high costs to the Authority. It is only effective if a biological phosphorus removal process is in operation.

Multiform Harvest™

Multiform™ Harvest Unit

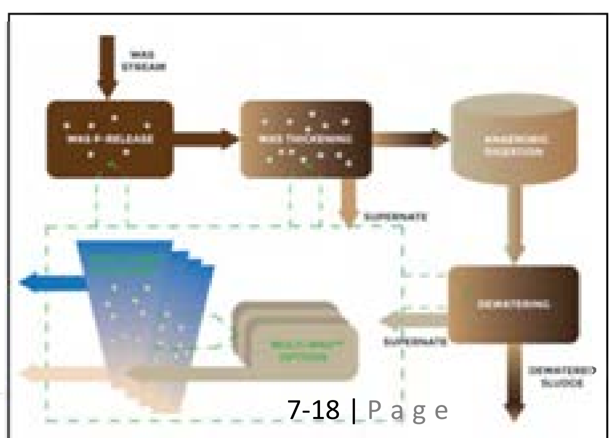


Multiform Harvest™ phosphorus recovery systems work by converting phosphorus and ammonia struvite (Magnesium Ammonium Phosphate hexa-hydrate $MgNH_4PO_4*6H_20$).

Wastewater is pumped through a fluidized bed where ideal conditions for crystallization are created. Magnesium chloride is added to the process, which is combined with dissolved phosphorus and ammonia to create natural crystalline struvite. This can remove up to 90 percent of the phosphorus in the wastewater stream. This is typically implemented on the wastewater stream after dewatering. In the case of the GWA, this system could be implemented as a sidestream process to reduce nutrient loading from the filtrate back to the biological process.

This system was designed for low maintenance and is simple to retrofit to meet the capacity of each plant. This system reduces biosolids mass potentially lowering sludge disposal costs up to 25 percent. The Multiform Harvest™ system is ideally suited for plants employing biological phosphorus removal and anaerobic sludge digestion. The system has been successfully used to process anaerobically digested filtrate and WAS filtrate.

Multiform™ Multi-Was Option



Ostara™

Ostara™ is a clean water product that uses technology developed at the University of British Columbia to remove nutrients from filtrate or centrate and convert them to a slow release fertilizer. The end product is more efficient than typical fertilizer therefore reducing runoff, and lowering the nutrient concentration from non-point sources. The system was conceived as a means to help meet ever lowering nutrient effluent limits and avoid issues with struvite buildup within wastewater treatment facilities from chemical and biological phosphorus removal.

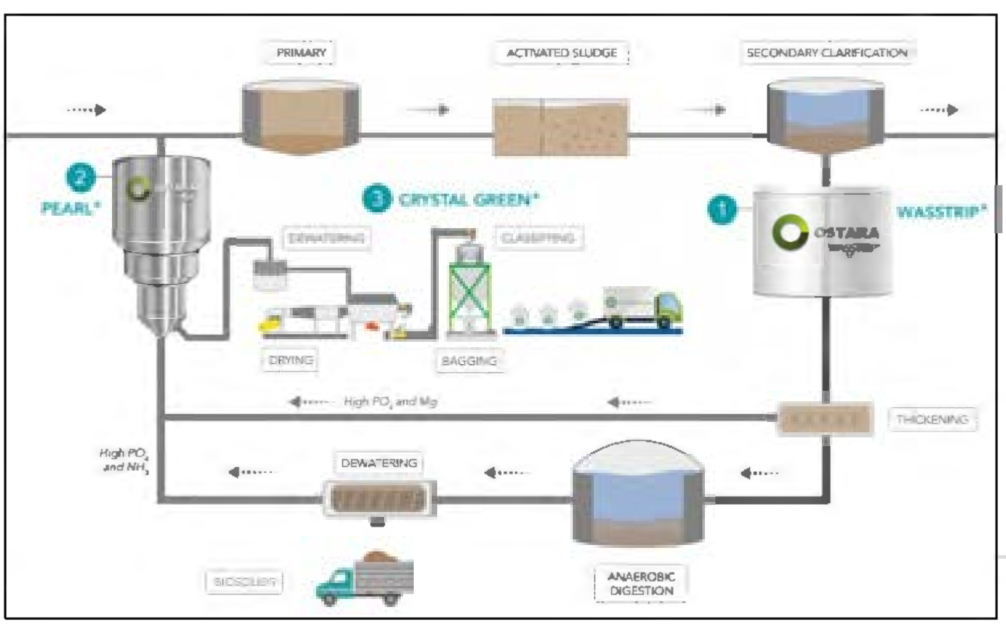
The Ostara™ process removes up to 90 percent of the phosphorus that would have typically been routed back to the head of the treatment plant. The system works through the implementation of two vessels: the Pearl process vessel and the WASSTRIP.

The WASSTRIP (short for waste activated sludge stripping to remove internal phosphorus) works by releasing phosphorus and magnesium from sludge upstream of the anaerobic digester and sending it directly to the Pearl process. This reduces biosolids production by lowering the nutrients available in the sludge during digestion and reduces struvite formation by redirecting nutrients upstream of the anaerobic digester.

The Pearl process intercepts the recycle flow and extracts phosphorus before it can be redirected to the head of the facility. It works by facilitating the crystallization of struvite by creating a controlled environment and through the addition of magnesium chloride to the vessel. In Bio-P plants, magnesium chloride is the limiting nutrient in struvite production. When magnesium chloride is added to the mixture, a chemical reaction will take place, bonding to nitrogen and phosphorus molecule, therefore removing them from the process. This creates struvite which is then harvested and used as a high quality slow release fertilizer.

In order for this technology to function as it was designed, the treatment plant must be using a biological phosphorus removal process removal as well.

Ostara™ Process

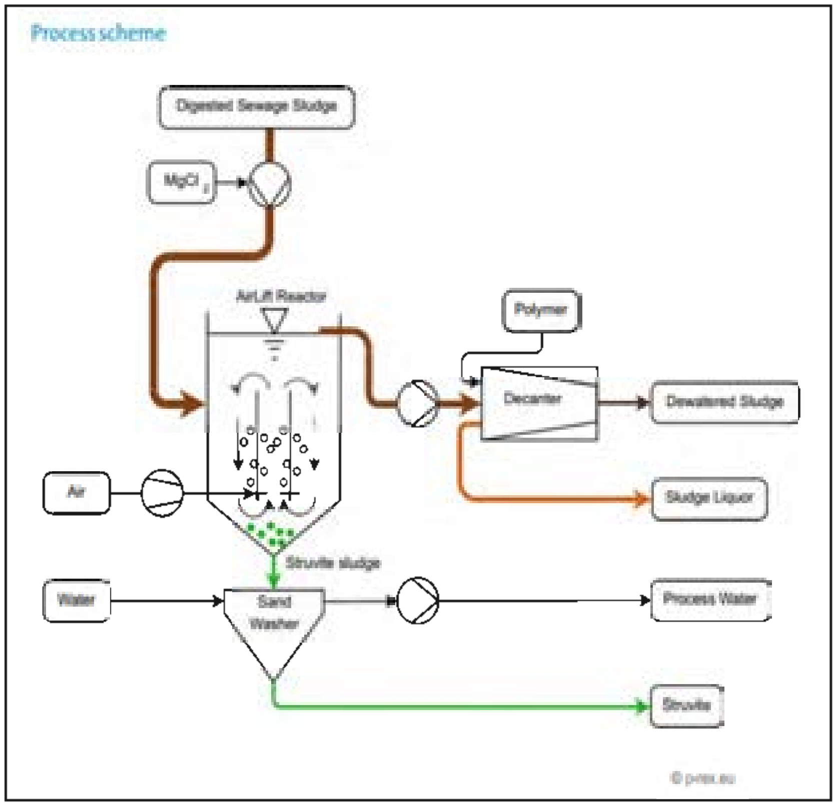


CNP AirPrex™

AirPrex™ is a sludge optimization and phosphorus recovery system that is installed between anaerobic digestion and sludge dewatering. The struvite precipitation occurs through air stripping in the AirPrex reactor with the addition of a magnesium chemical product.

The system was developed to prevent struvite incrustation after digestion, as well as improve biological phosphorus removal processes by reducing nutrient loading in the recycle stream. The AirPrex™ process uses Cl2 stripping with aeration to encourage a pH increase. Magnesium is added as $MgCl_2$ solution. The addition of magnesium, as well as the increased pH, causes the precipitation and sedimentation of struvite crystals. These crystals can then be harvested from the bottom of the reactor.

CNP AirPrex™ Process



The phosphorus recycle load can be reduced by as much as 90 percent with the AirPrex™ System. This leads to a lower phosphorus concentration being recycled to the beginning of the biological treatment process, creating a more efficient biological phosphorus removal process and a lower phosphorus concentration in the plant effluent. Phosphorus removed using AirPrex™ is recovered as struvite and can be used as a fertilizer. Sale of the fertilizer generates a return on the investment in the AirPrex™ equipment from sale of struvite for agricultural use.

AirPrex™ is used mainly for the optimization of the sludge dewatering process. This provides a further return on the investment by reducing sludge disposal costs by up to 20 percent. The AirPrex™ system was not initially promoted as a means to reduce phosphorus in side streams and effluent, but rather as a means to remove struvite from the digested sludge and therefore prevent the buildup of struvite and possible blockage of the piping.

7.4.2 Ammonia Reducing Sidestream Treatment

Reducing ammonia loading to the head of the plant through the filtrate will also improve the BNR processes. If this loading is eliminated, chemical may no longer needed to polish the process flow to meet limits. The following are several alternatives for reducing sidestream ammonia loading to the biological process.

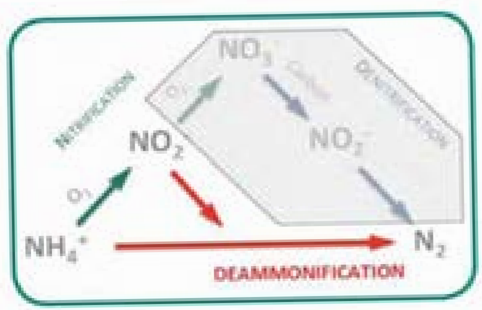
Traditional Nitrification/Denitrification

Filtrate can be treated with traditional nitrification/denitrification processes. These biological processes are relatively simple and stable, however they are energy intensive as oxygen is required to be supplied throughout the nitrification process. During the nitrification process, alkalinity as CaCO3 is utilized in the conversion of ammonia nitrogen to nitrate. Approximately 7.14 mg of alkalinity are used to convert each milligram of ammonia. Therefore, it is necessary to monitor the alkalinity available to the nitrification process to ensure that low pH does not inhibit the growth of bacteria. In sidestream processes where high ammonia levels are treated, there is a potential for low alkalinity (and therefore low pH) to limit the amount of ammonia converted.

Further evaluation would be required to determine if an additional source of alkalinity would be required to maintain a pH balance in the sidestream process. This alkalinity source can be additional waste activated sludge or a dosed chemical such as lime or sodium hydroxide.

To implement nitrification/denitrification, RAS or WAS could be mixed with filtrate to provide the required mass of nitrifying bacteria. This would require installation of new tanks, one anaerobic and one aerobic. A recycle pump station would be required, in addition to aerators, blowers, and WAS or RAS pumping to maintain the required MLSS concentration.

Anammox-Based Nitrification - DEMON ™



Anaerobic ammonium oxidation or “Anammox” is a process which short-circuits the conventional nitrification/denitrification process. *Nitrosomas* microbes first convert ammonia to nitrite under aerobic conditions, which requires a constant supply of low-pressure air. After a short detention period, the air supply is turned off and the process enters an anaerobic state. During this period, anammox bacteria perform deammonification converting nitrite directly to nitrogen gas without requiring an air supply. Several proprietary forms of the Anammox process exist within the domestic wastewater market.

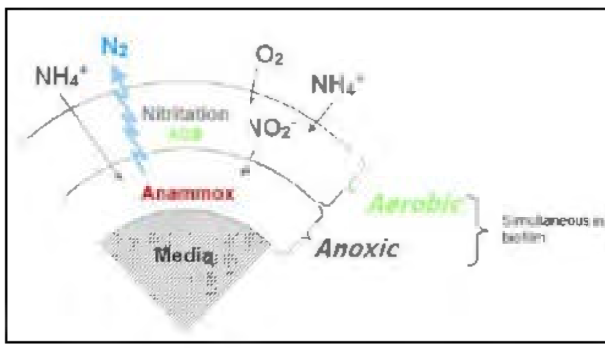
One such process is the DEMON® (an acronym for DEamMONnification) manufactured by World Water Works. The DEMON® system was the first Anammox process constructed in North America after being utilized throughout Europe. Through shunting the nitrification progression at nitrite, oxygen requirements are reduced by approximately 60%, sludge generation is reduced by more than 80%, and no external carbon or alkalinity source is required. World Water Works advertises an ammonia removal efficiency of 85-92% based on existing installations.

The DEMON® process operates in eight hour cycles, three times each day. The first phase is a six hour filtrate fill with alternating aeration and mixing. During the aerated portion of the phase, ammonia is converted to nitrite. Aeration is then stopped and anammox bacteria convert the nitrite to nitrogen gas. Operational control is provided through maintaining pH fluctuations during the fill phase. Acid is formed during nitrification lowering the pH. After a drop of 0.01 units, aeration is stopped and the process enters an anaerobic phase performing deammonification. The pH subsequently rises and the sequence is repeated.

Sludge is wasted through a cyclone system which separates and retains the heavier anammox bacteria while wasting the lighter ammonia oxidizing bacteria (A/OBs). This allows a decoupling of the SRT to provide approximately 50 days SRT for anammox bacteria and 3 days SRT for A/OB's. Due to the cyclical nature of the DEMON® process, an upstream equalization basin is required to provide detention during non-fill phases of the process. This equalization basin would also serve to provide a consistent flow throughout the day and over days when sludge dewatering is not performed. The process would require seed sludge from an existing installation for startup.

Anammox-Based Nitrification – Anita MOX™

The ANITA™ Mox process, manufactured by Kruger, Inc., is another Anammox process for sidestream ammonia removal. This system utilizes a moving bed biofilm reactor (MBBR) technology to provide nitrification and deammonification of high strength wastes. Two different layers of bacteria grow on polyethylene carriers, allowing for simultaneous aerobic nitration and anoxic ammonia oxidation reactions to take place. The outer layout of biofilm consists of *Nitrosomas* which convert ammonia to nitrite under aerobic conditions. The inner layer of biofilm is comprised of anammox bacteria which utilize the converted nitrite and remaining ammonia, producing nitrogen gas.



The ANITA™ Mox system is capable of removing up to 90% of ammonia and 85% of total nitrogen. Similar to the DEMON process, the ANITA™ Mox requires approximately 40% of the oxygen demand of conventional nitrification, and requires no external carbon source. This system utilizes a medium bubble aeration grid across the tank floor and submersible mixers. Two positive displacement blowers (one duty and one standby) are typically recommended. The entire biomass is grown on the carriers, and is retained in the system by media screens which prevent it from wasting. The growth rate of the individual bacteria species determines the SRT – since the anammox bacteria has a very slow growth rate it is imperative that this bacteria is not routinely wasted. Kruger's typical scope of supply for the ANITA™ Mox system includes the polyethylene media, media screens, aeration system, mixers, blowers and local instrumentation and control equipment. Similar to the DEMON process, the ANITA™ Mox system requires upstream equalization if centrate is not supplied to the process at a constant rate.

7.5 PREVIOUS NUTRIENT REMOVAL STUDIES

The Authority has commissioned a number of studies over the years which have incorporated or specifically reviewed long-term nutrient removal and biological process alternatives. These include the 2006 Facilities Plan, the 2013 Facilities Plan, the 2017 Phosphorus Feasibility Study, and the 2017 series of Technical Memorandums on phosphorus removal. This section will provide a brief review of each of these studies to document the assumptions made and recommendations given at each step.

7.5.1 2006 Facilities Plan

Prepared by Strand Associates, Inc., the Authority's 2006 Facilities Plan identified significant upgrades and rehabilitation necessary for the high-purity oxygen biological process. This included all equipment associated with the two-stage process, as well as the cryogenic plant which was estimated to require a major overhaul within the next ten years. Six alternatives were developed for rehabilitation and/or replacement of the two-stage high purity oxygen activated sludge (TS-HPOAS) system as follows:

Alternative #1 – Regular maintenance of the TS-HPOAS process with no major modifications.

Alternative #2 – Maintain all existing components with replacement of the cryogenic compressor with a smaller unit to reduce wasted oxygen.

Alternative #3 – Maintain all existing components; replace the cryo generation with a refurbished 13 ton/day pressure swing adsorption unit, replace aerators and controls.

Alternative #4 – Maintain all existing components; replace the cryo generation with a new 16 ton/day vacuum swing adsorption unit, replace aerators and controls.

Alternative #5 – Maintain all existing components; replace the cryo generation with purchased and hauled liquid oxygen, replace aerators and controls.

Alternative #6 – Discontinue TS-HPOAS process and convert to single-stage air activated sludge.

To normalize the capital and O&M costs associated with each alternative, a present worth analysis was completed (below). Alternatives #1 & 2 include replacement of UNOX aerators, cryo heat exchanger, and cryo controls in the 10-year timeframe, and Alternatives #1-5 include CRAS pump replacement.

Alternative	@7.5¢/kWH Present Worth	@7.5¢/kWH Rank	@8.5¢/kWH Present Worth	@8.5¢/kWH Rank	@9.5/kWH Present Worth	@9.5/kWH Rank
1. No Change	$10.3	2	$11.1	2	$11.8	2
2. Smaller Compressor	10.1	1	10.8	1	11.5	1
3. Refurbished PSA	11.5	3	12.1	3	12.6	3
4. Purchased VSA	11.7	4	12.2	4	12.7	4
4a. Leased VSA	12.9	7	13.4	7	13.9	7
5. Liquid O_2	12.3	5	12.7	5	13.1	5
6. Air Activated Sludge	12.3	6	13.0	6	13.4	6

Note: Discount rate = 5.875 percent; 20-year project life; cost shown are in millions of dollars.

Table 6.03-4 Opinion of Present Worth

Ultimately, the Plan recommended that the Authority select either Alternative #1 or #2 due to the lower present worth cost and relatively unknown future of nutrient removal requirements. Phosphorus removal was reviewed outside of the context of the biological process, and included an overview of biological and chemical phosphorus removal processes. While the Plan did not recommend planning for one system as opposed to the other, it did note that if biological phosphorus removal is implemented consideration should be given to conversion to single-stage due to oxygen saturation. Additionally, the Plan recommended constructing a chemical polishing/backup facility in the event biological phosphorus removal was selected.

7.5.2 2013 Facilities Plan

In 2013 Strand Associates, Inc. completed another Facilities Plan for the Glenbard Wastewater Authority. Since the previous Plan the existing facilities had been maintained, but no major upgrades or rehabilitations were completed for the biological process or for nutrient/phosphorus removal. This Plan considered future nutrient removal requirements (both total nitrogen and phosphorus) in conjunction with the rehabilitation required for the biological process. Taking into account pending nutrient removal requirements, the following four alternatives were developed:

Alternative #1 – Maintain the TS-HPOAS process and continue cryogenic oxygen generation onsite.

Alternative #2 – Convert to single-stage HPO and continue cryogenic oxygen generation onsite.

Alternative #3 – Convert to single-stage air activated sludge and install new aeration/blowers.

Alternative #4 – Convert to single-stage IFAS with new aeration system and blowers.

Due to the short hydraulic retention times in the existing HPO basins, conversion to traditional process air activated sludge systems as detailed in Alternatives #3 & 4 would require construction of additional tankage. It was estimated that Alternative #3 would require the construction of 2.8 MG of additional tankage to provide 4.2 hours additional HRT for a total of 6.0 MG or 9.0 hours HRT. Alternative #4 included 1.4 MG of additional tankage to provide 4.6 MG total or 6.9 hours HRT.

It should be noted that the basin volumes and associated retention times calculated are based on a 127 ft basin length. The actual basin length is 120 ft, and as such the total volume is approximately 5% less that that calculated in the Plan. This further reduces the hydraulic retention times by roughly one half hour in each scenario.

Each of the four alternatives outlined include reconfiguration of the first stages (except carbo in Alt. #1) of each train to anoxic basins with mixers, and construction of a new nitrate recycle station. This is intended to provide the denitrification necessary to meet a total nitrogen limit of 10.0 mg/L.

Additionally, Alternative #1 includes rehabilitation of the Intermediate Clarifiers and Intermediate Pump Station; Alternatives #2, 3 & 4 includes demolition of the Intermediate Clarifiers and repurposing the Intermediate Pump Station as RAS pumping. The Opinion of Present Worth for each of these alternatives are included on the following page.

	Alternative			
	AS-1 Two Stage HPOAS	AS-2 Single Stage HPOAS	AS-3 Air Activated Sludge	AS-4 IFAS
Opinion of Capital Costs	$ 4,653,000	$ 3,582,000	$ 17,451,000	$ 24,303,000
Annual O&M Costs				
Relative Labor	$ 63,000	$ 62,000	$ 41,000	$ 36,000
Maintenance	$ 171,000	$ 164,000	$ 58,000	$ 108,000
Power	$ 312,000	$ 284,000	$ 207,000	$ 285,000
Subtotal Opinion of Annual O&M[1]	$ 546,000	$ 510,000	$ 306,000	$ 429,000
Present Worth of O&M	$ 6,263,000	$ 5,850,000	$ 3,510,000	$ 4,921,000
Present Worth of Future Equipment	$ -	$ -	$ -	$ -
Present Worth of Salvage	$ (109,000)	$ (84,000)	$ (733,000)	$ (468,000)
TOTAL OPINION OF PRESENT WORTH[1]	$ 10,807,000	$ 9,348,000	$ 20,228,000	$ 28,756,000
Percent of Lowest (Present Worth Basis)	116%	100%	216%	308%

[1] Project life = 20 years; discount rate = 6 percent.
[2] Refer to Appendix E for further opinion of cost details.

Table 7.03-1 Activated Sludge Treatment Opinion of Present Worth Summary[2]

It is recommended that if any of these alternatives are given further consideration, the biological process should be modeled to determine whether sufficient aerobic retention time is provided at design loading under winter conditions. Maintaining the TS-HPOAS of Alternative #1 is anticipated to provide the requisite nitrification and BOD removal for future loading, however repurposing a portion of these basins to anoxic may jeopardize nitrification under heavy loading/low temperature conditions. This similarly applies for conversion to single-stage HPO (Alternative #2) where the reduced hydraulic retention times would likely exacerbate future nitrification issues. The additional basins constructed in Alternative #3 would provide a total of 8.5 hours HRT (accounting for corrected basin length). Assuming an anoxic HRT of roughly 2.0 hours HRT, this leaves 6.5 hours for BOD removal and nitrification. While this may be sufficient depending on future loading, a minimum of 8.0 hours would provide a more conservative design value. The 6.5 hours HRT of Alternative #4 would allow for 4.5 hours aerobic HRT following the anoxic zone. Even with the implementation of IFAS to increase the biomass, it is unlikely that a high enough effective MLSS could be maintained to provide nitrification under winter design-loading conditions.

The 2013 Facilities Plan included a review of phosphorus removal alternatives as well. Based on BPR testing performed by the GWA in 2012, it was found that supplemental carbon in the form of fermented VFA's or acetate augmentation would likely be required due to low influent rbCOD. Due to the low influent rbCOD concentration, coupled with the capital cost associated with conversion to single-stage air activated sludge necessary to perform BPR, the Plan ultimately recommended construction of chemical phosphorus removal facilities. It was also noted that even in BPR was implemented, the chemical polishing/backup facilities would still be necessary in the event of biological upsets.

7.5.3 2017 Technical Memorandums on Phosphorus Removal

In 2015 the Authority commissioned Baxter and Woodman in conjunction with the Danish Hydraulic Institute (DHI) to prepare a feasibility study of implementing enhanced biological phosphorus removal (EBPR). This analysis included biological modeling of several process alternatives with three Milestones delineated as part of the study. Those milestones are as follows:

Milestone #1 – Biological process modeling of a sidestream EBPR system.

Milestone #2 – Evaluation of sidestream nutrient removal/reduction alternatives.

Milestone #3 – Prepare cost estimates for the recommended improvements.

The process layout that was modeled included converting the TS-HPOAS system to traditional diffused air aeration, repurposing the Intermediate Clarifiers for use as anaerobic basins, reconstruction of the Intermediate Screw Pump Station as a submersible lift station, and installation of a proprietary DHI control software system.

The biological process modeling of Milestone #1 found that while total phosphorus in the secondary effluent exceeded 1.0 mg/L under winter conditions, it was anticipated that this would be further reduced through the newly installed disc filters as the soluable phosphorus was below 1.0 mg/L.

While the modeling performed indicated that achieving a 1.0 mg/L is feasible, a number of assumptions were made in order for the modeling to support this conclusion. Several of those assumptions which would require further modeling and evaluation to validate are included below:

- Minimum temperature modeled was 10°C; data indicates 9°C has been observed at the plant. Temperature differences at this level have a significant impact on nitrification.
- A design influent ammonia concentration (and calculated loading) of 14.9 mg/L was utilized. Actual influent to the plant is 22.5 mg/L. Accounting for recycle filtrate load this may be closer to 18 mg/L actual influent. The assumed 14.9 m/L represents a 20% difference in loading. It appears this is based on a build-out PE loading at IEPA design values, and a build-out flow of 16.02 MGD. This method of estimation results in assuming a significant dilution effect of future growth.
- A design influent BOD of 59 mg/L was utilized. Actual primary effluent BOD over the past five years is 100 mg/L. This assumption represents a difference of 70% in actual loading. It appears this concentration was derived in the same manner as ammonia, requiring future dilution.
- A peaking factor of 1.5 was utilized to determine flow through the process and estimate the likelihood of washout. This equates to 24 MGD. Actual flow through a converted single-stage process would be 47 MGD, the Authority's Design Maximum Flow.
- A target mixed liquor concentration of 4,100 mg/L is utilized in the winter estimates. At 16.02 MGD DAF this would require 34 MGD of RAS at 6,000 mg/L to maintain biomass. At 47 MGD DMF this would require a return rate of 98 MGD. It is unlikely this can be sustained in the field.
- The effluent results exceed 1.0 mg/L TP and require further removal through disc filters to meet limits. At 10 µm filter media the remainder of particulate should not be assumed to be removed.

The results indicated in the Milestone #1 modeling efforts also required a carbon supplementation of between 2,850 lbs/day to 4,000 lbs/day on an annual average basis. This would correlate to an annual average cost of $450,000 – $700,000 at $2.60/gallon of acetate. The 2017 Phosphorus Feasibility Study and 2013 Facility Plan estimated this annual cost at $1.82M/year, while the 2017 Technical Memorandum #3 estimated the same cost at $490,000 annually. Additionally modeling would be necessary to reconcile these estimates, as over a 20-Year present worth this discrepancy correlates to more than $26.6M.

7.6 Alternatives For Biological Process and Nutrient Removal

The Authority is at a crossroads in regards to the future of the biological process. Much of the existing two-stage high-purity oxygen system equipment is very near the end of its useful service life. This includes the UNOX mixers, carbo RAS pumps, the cryogenic oxygen generation system, intermediate clarifier mechanisms and telescoping valves, two of the intermediate screw pumps, and associated electrical and control equipment. Reinvesting into this equipment represents a commitment to maintaining the TS-HPOAS system in at least the mid-term.

The TS-HPOAS would not be able to perform biological phosphorus removal or denitrification as currently configured. While chemical phosphorus removal likely presents the most cost-effective solution to effluent phosphorus requirements, this does not accommodate future total nitrogen requirements. In the current regulatory environment, a TN limit of at least 10 mg/L, and possibly 7-8 mg/L range will likely come to fruition. The timeline for implementation of a TN limit is currently unknown, however it may be within two permit cycles, resulting in a compliance period of 10-15 years. Therefore, any major capital improvements completed today should allow for upgrades in the future to meet these requirements.

As identified in the 2013 Facilities Plan, it is recommended that any future phosphorus removal process include chemical polishing or backup at a minimum. This is due to the inherent biological upsets that are associated with bio-p. The capital infrastructure associated with chemical polishing facilities is not appreciably less than that associated with straight chemical phosphorus removal. Slightly larger pumps and larger storage would be required for chem-p, but the scale will be similar. Therefore, understanding that any phosphorus removal upgrades in the future will include provisions for phosphorus removal, it is recommended that the Authority plan for implementation of chemical phosphorus removal rather than biological. It is recommended that the GWA invest in additional biological modeling of any proposed process as part of the conceptual design of phosphorus removal. The capital cost of chem-p facilities for similarly sized facilities has been estimated at approximately $1.5M to meet a 1.0 mg/L TP limit. This would allow for future tank and pump expansion to meet lower limits as well.

Meeting future TN limits would require the Authority to convert to a traditional diffused air activated sludge process. The supersaturation of oxygen within the MLSS and RAS prohibits effective denitrification under a HPO condition. Therefore, the GWA must consider the cost of converting to conventional single-stage nitrification versus the capital requirement to maintain the TS-HPOAS until such a time as TN limits are imposed. The estimated cost of these improvements is approximately $27.7 Million, as identified in the 2013 Facility Plan. However, this estimate should be revisited as the regulations are solidified and the Authority updates the facility plan.

Conversion to a single-stage nitrification with diffused air would require a number of modifications to the existing biological process, as well as an expansion of the existing tankage. The upgrades required would generally include:

- Demolition of the UNOX mixers and installation of vents
- Demolition of the Carbo RAS Pump Station
- Rehabilitation of the Int. Screw Pump Station as RAS pumping (or conversion to submersible)
- New primary effluent piping and diversion channel to the biological process
- New Blower Building with electrical and controls for biological process
- Extension of the biological process tankage to incorporate 2.4 MG of additional aerobic detention
- New diffused-air aeration system in the biological process

A planning-level opinion of probable cost is included below, which estimates the capital requirement for conversion at approximately $24.5M. The 2013 Facilities Plan estimated the capital required for this conversion and expansion at approximately $17.5M, which would equate to $21.0M in 2018 dollars.

Biological Process Alternatives - Conversion to Single Stage Nitrification	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$2,615,834
SITE WORK	$1,485,000
UNOX DECK MODIFICATIONS	$8,319,070
DEMO CRAS STATION	$359,020
DEMO INTERMEDIATE CLARIFIERS	$437,270
INTERMEDIATE SCREW PUMP STATION REHABILITATION	$2,719,880
BLOWER/ELECTRICAL BUILDING	$2,495,045
Construction Sub-Total	$18,431,119
Contingency @ 15%	$2,764,668
Engineering @ 15%	$3,179,368
PROBABLE PROJECT COST:	**$24,375,155**

As the exact TN requirements and timeline for compliance within these limits is not known at this time, the Authority may elect to rehabilitate the existing TS-HPOAS and potentially the cryogenic oxygen generation plant. In 2011, the Authority commissioned an Asset Analysis report that provided estimated costs for rehabilitation of major plant components. This study estimated the replacement cost of the UNOX mixers, air valves, and controls at $1.7M. Escalated to 2018 dollars, this is approximately $2.15M. Additionally, the Intermediate Clarifiers, Intermediate Screw Pump Station, and Carbo RAS Station all require rehabilitation, estimated at a total of $2.75M based on the condition assessment tables included in Section 9. This equates to a total equipment replacement cost of approximately $4.90M to maintain the TS-HPOAS system in operation through the planning horizon.

Additionally, the 2011 Asset Analysis estimated the cost for rehabilitation of the cryogenic facility at approximately $2.9M. This included replacement of the coldbox, air compressor, turbine, reverse heat exchanger, oxygen supply piping, valves, and controls upgrades. Adjusted to 2018 dollars this correlates to an investment of $3.67M. A cost-effective analysis of capital reinvestment versus maintaining third-party hauling of liquid oxygen is outside of the scope of this project, but should be completed if the Authority is considering rehabilitating the existing TS-HPOAS process.

7.7 Recommendations

The next 10-15 years will likely see significant regulatory modifications, including total phosphorus limits, total nitrogen limits, and reduced ammonia limits. The actual effluent limits associated with each of these parameters is unknown but will require major modifications to the Authority's biological and supporting processes. Due to the relatively unknown nature of these pending requirements, it is not recommended that the Authority invest significant capital into a process designed to meet one or more specific criteria. For example, conversion to a biological phosphorus removal process capable of meeting a 1.0 mg/L limit may not be able to meet the potential 0.5 mg/L limit. That same process may not be capable of full denitrification for total nitrogen removal.

Therefore, it is recommended that the Authority maintain the existing TS-HPOAS process until such a time as TN and ammonia limits are determined. The Authority's NPDES permit does require compliance with the existing 1.0 mg/L TP limit however, effective in 2025. The most cost-effective method of achieving continuous compliance with this standard is implementing chemical phosphorus removal. This would consist of a chemical storage and feed building, likely north of the existing biological process. Multiple dosing locations would be constructed, which would be identified during a preliminary jar-testing phase. This project also includes sidestream chemical removal equipment for precipitation of phosphorus upstream of dewatering, and instrumentation within the aeration basins for process control. The cost of this project is estimated at $2.25M and a conceptual opinion of probable project cost (OPPC) is included on the following page. This facility would be utilized by the Authority in all future TP and TN removal systems and would be required regardless of future processes implemented.

Additionally, in order to maintain the existing biological and support processes, several capital projects and equipment replacement would be required. The Intermediate Pump Station will require rehabilitation within the 10-Year CIP. This process would likely be utilized as RAS pumping for all future processes incorporated, and represents a long-term investment. It is recommended that the center and west augers be replaced, and the bearings, drives, gearboxes, and all electrical and control equipment be replaced. This project is estimated at $1.9M and a conceptual OPPC is included on the following page.

The Intermediate Clarifiers are also in need of major rehabilitation, which is estimated to be required within the 10-Year CIP. This process may not be utilized following incorporation of future biological processes, and as such a minimum capital investment should be made to maintain operation until such a time as other processes are implemented. This project would include replacement of the clarifier mechanisms, walkways, and telescoping valves. This project is estimated at $1.24M and a conceptual OPPC is included for this project on the following page.

Finally, the Carbo-RAS pumps and other pieces of equipment will likely require rehabilitation or replacement within the 10-Year CIP. These minor components have been incorporated into the annual equipment replacement schedule identified in Section 9 of this report. It is anticipated that these rehabilitations or replacements would be budgeted through either the Small Capital Projects ($100,000/year), Infrastructure Improvements ($300,000/year), or Plant Equipment Rehabilitation ($300,000/year) budget line items.

Chemical Phosphorus Removal (1.0 mg/L)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$350,532
SITE WORK	$275,250
BIOLOGICAL PROCESS I&C	$110,000
CHEMICAL FEED BUILDING	$856,600
SIDESTREAM CHEMICAL SYSTEM	$104,250
Construction Sub-Total	$1,696,632
Contingency @ 15%	$254,495
Engineering @ 15%	$292,669
PROBABLE PROJECT COST:	**$2,243,796**

Intermediate Pumping Station Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$205,772
SITE WORK	$30,500
INTERMEDIATE PUMPING STATION	$1,167,600
Construction Sub-Total	$1,403,872
Contingency @ 15%	$210,581
Engineering @ 15%	$242,168
PROBABLE PROJECT COST:	**$1,856,621**

Intermediate Clarifier Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$156,720
SITE WORK	$30,500
INTERMEDIATE CLARIFIERS	$750,500
Construction Sub-Total	$937,720
Contingency @ 15%	$140,658
Engineering @ 15%	$161,757
PROBABLE PROJECT COST:	**$1,240,135**

SECTION 8
ENVIRONMENTAL IMPACTS

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8. Environmental Impacts

8.1 Anti-Degradation Analysis

The Authority is responsible for providing wastewater collection and treatment services to support development throughout the entire Facility Planning Area. As the designated management agency, the Authority is also responsible for meeting the long-range goals of the Clean Water Act and to minimize the environmental impacts of pollution discharged from the Glenbard Advanced Wastewater Treatment Facility (GAWTF). As noted in Section 2 of this Facility Plan, the projected future three-month low flows and loadings at the GAWTF are not expected to exceed 80% of the Facility's design capacities, indicating that expansion will not be needed but should be re-evaluated during the next planning period.

8.2 Environmental Areas of Concern

Areas of environmental concern include the East Branch of the DuPage River, as well as the wetlands and nature preserves within the facility planning area. The most significant concern for the Authority includes the quality of the final effluent. The facility's current effluent quality is exceptional. However, concerns over impacts on the surrounding environment including wetlands, wildlife habitats, and endangered species must be considered. The impact on the waterway depends on factors such as the volume and quality of the effluent being discharged, as well as the ability of the receiving waterway to dilute and assimilate contaminants.

8.2.1 Water Quality Concerns

The Clean Water Act was established to protect and revive the lakes, rivers, and streams of the United States. Restoring their quality is crucial in maintaining a healthy environment and ensuring the sustainability of these waters for all to use and enjoy.

Title 35 of the Illinois Administrative Code, Section 302 establishes the method for determining, implementing, and regulating Water Quality Standards. Section 302.105 – Anti-Degradation has been added to protect existing uses of all waters, maintain the quality of waters, and prevent unnecessary deterioration of the waterways.

The Clean Water Act also established the NPDES Permitting program managed by the individual state agencies. The program establishes effluent limits that the Publicly Owned Treatment Works (POTWs) must meet. The Authority's WWTP has consistently been in compliance with its NPDES Permit effluent limits.

There are two methods of determining effluent limits. The first is Water Quality Based Effluent Limits (WQBEL's). WQBEL's have historically been used throughout Illinois to establish the NPDES Permit effluent limits for POTW Discharges.

The second method is to study a particular body of water and establish a Total Maximum Daily Load (TMDL) based on the ecosystem's ability to receive pollutants without having an adverse effect on the stream's ability to support its designated uses. By taking a watershed approach, a TMDL considers all potential sources of pollutants including point and non-point sources. It also takes into account a margin of safety, which reflects scientific uncertainty and future growth. The effects of seasonal variation are also included.

TMDL's are calculated using the following formula:

$$TMDL = WLA + LA + MOS + SV$$

Where:

WLA = Waste Load Allocation (point sources)

LA = Load Allocation (non-point sources)

MOS = Margin of Safety

SV = Seasonal Variation

Section 303(d) of the Clean Water Act requires each state to prepare a list of waters that are considered to be impaired for their intended uses. In 2016, the Illinois EPA issued a revised Integrated Water Quality report and Section 303(d) List. Portions of the East Branch of the DuPage River are impaired for aquatic life based on total suspended solids (TSS), phosphorus, and several other contaminants.

The Authority's WWTP discharges to segment GBL-010, which includes 4.64 miles of the East Branch of the DuPage River. This segment has been identified as impaired and classified as a medium priority for six criteria and low priority for one criteria. The assessment was based on site-specific data and concluded that segment GBL-010 was not supporting aquatic life, fish consumption, and primary contact. A summary of these impairments and their causes are shown below:

Table 5-1: Summary of the East Branch of the DuPage River Impairments

Order	Priority	Hydrologic Unit Code	Water Name	Water Size	Designated Use	Cause
299	Medium	0712000408	East Branch DuPage River	4.64	Aquatic Life	Arsenic
300	Medium	0712000408	East Branch DuPage River	4.64	Aquatic Life	Dieldrin
301	Medium	0712000408	East Branch DuPage River	4.64	Aquatic Life	Hexachlorobenzene
302	Medium	0712000408	East Branch DuPage River	4.64	Aquatic Life	Methoxychlor
303	Medium	0712000408	East Branch DuPage River	4.64	Aquatic Life	Phosphorus (Total)
304	Medium	0712000408	East Branch DuPage River	4.64	Fish Consumption	Polychlorinated Biphenyls
2679	Low	0712000408	East Branch DuPage River	4.64	Primary Contact Recreation	Fecal Coliform

The Illinois EPA defines the potential causes and sources of impairment for water bodies. Specific assessment information was provided by the IEPA for segment GBL-010, and the causes of these impairments are listed as codes which are summarized below:

Table 5-2: Causes of Impairments

Cause ID	Description
84	Alteration in stream-side or littoral vegetative covers
96	Arsenic
138	Chloride
198	Dieldrin
246	Hexachlorobenzene
277	Methoxychlor
348	Polychlorinated biphenyls
400	Phosphorus (Total)
462	Phosphorus (Total)
501	Loss of Instream Cover

The sources of the impairments were also listed as codes in the specific assessment, which are summarized below:

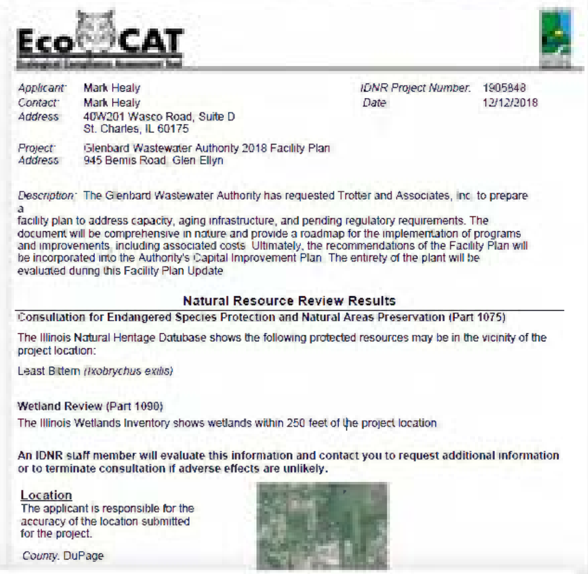
Table 5-3: Sources of Impairment for Segment GBL-010 of the East Branch of the DuPage River

Source ID	Potential Source Description	Potential Source Guidelines for Identification*
20	Channelization	Straightening of stream meanders based upon actual observation and/or other existing data.
28	Combined Sewer Overflows	Combined sanitary and storm sewer overflow based upon Facility Related Stream Survey, Agency effluent monitoring, Discharge Monitoring Reports and/or other existing data.
85	Municipal Point Source Discharges	Municipal point source discharge based upon Facility-Related Stream Survey, Agency effluent, DMR and/or other existing data.
177	Urban Runoff/Storm Sewers	Urban and storm sewer runoff based upon actual observation and/or other existing data
140	Source Unknown	No identifiable source based upon available information

**Excerpt from Integrated Water Quality Report and Section 303(d) List – Volume I: Surface Water*

8.2.2 Threatened and Endangered Species

The Illinois Department of Natural Resources offers an Ecological Compliance Assessment Tool (EcoCAT) that analyzes a given area and provides a list of protected resources in the vicinity of the project location. An EcoCAT consultation was conducted for the areas surrounding the wastewater treatment facility and it was ultimately determined that the Illinois Natural Heritage Database contains the potential for the Least Bittern to be in the vicinity of the treatment plant.



EcoCAT

Applicant: Mark Healy
Contact: Mark Healy
Address: 40W201 Wasco Road, Suite D
St. Charles, IL 60175

IDNR Project Number: 1905848
Date: 12/12/2018

Project: Glenbard Wastewater Authority 2018 Facility Plan
Address: 945 Bemis Road, Glen Ellyn

Description: The Glenbard Wastewater Authority has requested Trotter and Associates, Inc. to prepare a
facility plan to address capacity, aging infrastructure, and pending regulatory requirements. The document will be comprehensive in nature and provide a roadmap for the implementation of programs and improvements, including associated costs. Ultimately, the recommendations of the Facility Plan will be incorporated into the Authority's Capital Improvement Plan. The entirety of the plant will be evaluated during this Facility Plan Update

Natural Resource Review Results

Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Least Bittern *(Ixobrychus exilis)*

Wetland Review (Part 1090)

The Illinois Wetlands Inventory shows wetlands within 250 feet of the project location

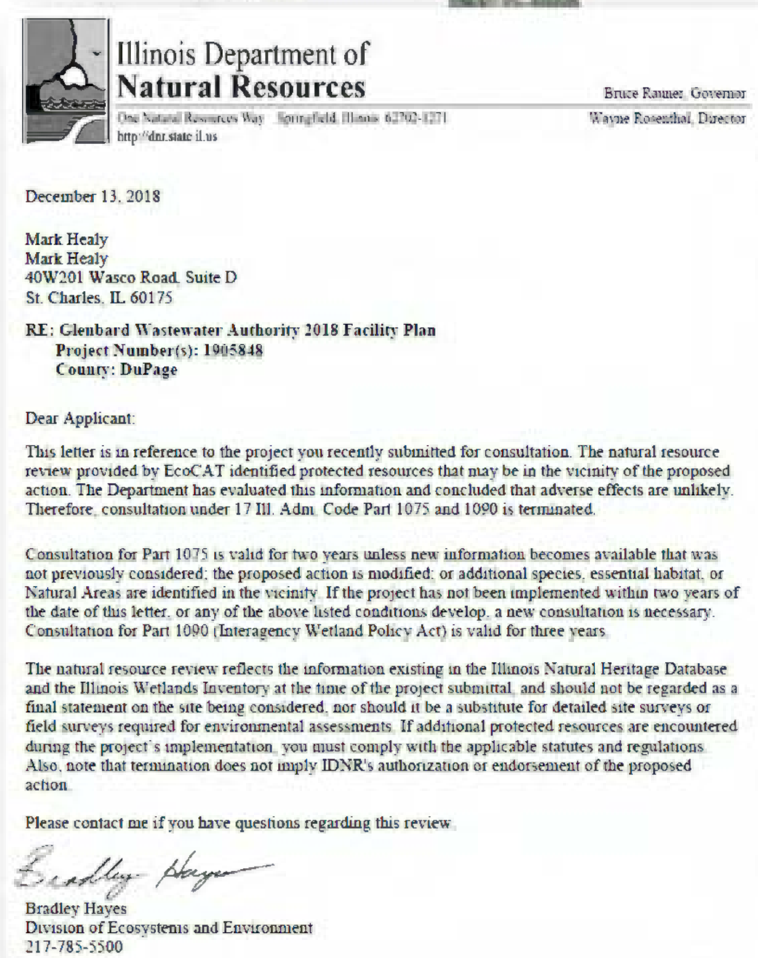
An IDNR staff member will evaluate this information and contact you to request additional information or to terminate consultation if adverse effects are unlikely.

Location
The applicant is responsible for the accuracy of the location submitted for the project.

County: DuPage

As part of the submission process the application is reviewed by the IDNR and a formal termination letter may be provided. In the case of the Authority, a response has been received. Although the WWTP boundary has identified the Least Bittern to be in the vicinity, it was determined that adverse effects are unlikely if modifications are made.

The letter from the IDNR and the overall determination/termination is valid for a period of two years, and any projects that are completed within that timeline do not need to be resubmitted. However, once that timeline has expired, an additional determination is required.



Illinois Department of
Natural Resources
One Natural Resources Way Springfield, Illinois 62702-1271
http://dnr.state.il.us

Bruce Rauner, Governor
Wayne Rosenthal, Director

December 13, 2018

Mark Healy
Mark Healy
40W201 Wasco Road, Suite D
St. Charles, IL 60175

RE: Glenbard Wastewater Authority 2018 Facility Plan
Project Number(s): 1905848
County: DuPage

Dear Applicant:

This letter is in reference to the project you recently submitted for consultation. The natural resource review provided by EcoCAT identified protected resources that may be in the vicinity of the proposed action. The Department has evaluated this information and concluded that adverse effects are unlikely. Therefore, consultation under 17 Ill. Adm. Code Part 1075 and 1090 is terminated.

Consultation for Part 1075 is valid for two years unless new information becomes available that was not previously considered; the proposed action is modified; or additional species, essential habitat, or Natural Areas are identified in the vicinity. If the project has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary. Consultation for Part 1090 (Interagency Wetland Policy Act) is valid for three years.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database and the Illinois Wetlands Inventory at the time of the project submittal, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, you must comply with the applicable statutes and regulations. Also, note that termination does not imply IDNR's authorization or endorsement of the proposed action.

Please contact me if you have questions regarding this review.

Bradley Hayes

Bradley Hayes
Division of Ecosystems and Environment
217-785-5500

8.2.3 Illinois Historic Preservation

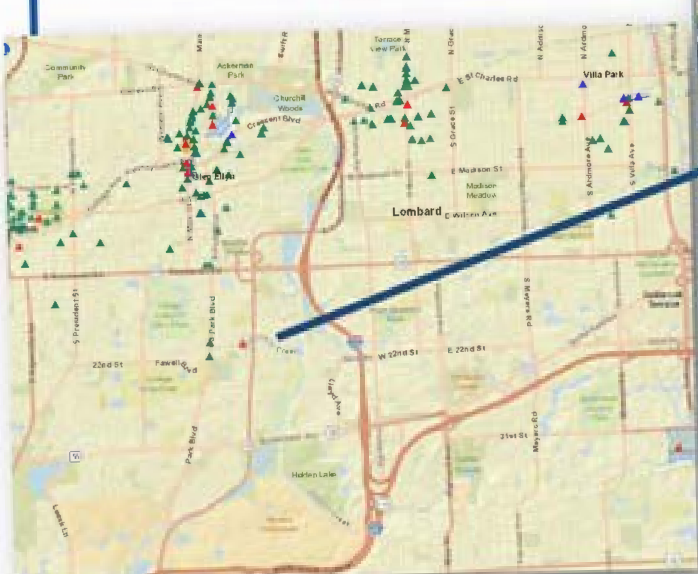
The Historic and Architectural Resources Geographic Information System (HARGIS) tool provided by the Illinois DNR Historic Preservation Division was utilized to determine whether any known historical sites exist within the property boundaries of the Authority's WWTP and where proposed improvements are to be constructed as outlined in this report. From this tool, it is anticipated that there will be no impact to sites of historic or architectural significance.

The Illinois State Historic Preservation Agency (IHPA) has been contacted regarding the different project locations that have been outlined within this report. The submitted documentation will be reviewed by the IHPA, and an official determination will be provided. As previously stated, it is anticipated that a letter of no objection will be obtained by the Authority. The letter from the IHPA and the overall determination/termination is valid for a period of two years, and any projects that are completed within that timeline do not need to be resubmitted. However, once that timeline has expired, an additional determination is required.

8.2.4 Input from Stakeholders

The USEPA, along with the IEPA, is currently considering alternatives to limit nutrient concentrations in an effort to reduce or eliminate local water quality impairments as well as hypoxia in the Gulf of Mexico. As discussed in Section 7, the Illinois EPA is focused on statewide nutrient removal criteria for wastewater treatment facilities. The Illinois EPA, along with the DuPage River Salt Creek Work Group and other stakeholders, are developing solutions to address the impairments found along the DuPage River.

For many years, the IEPA has enforced nutrient removal criteria for treatment facilities seeking to expand their hydraulic capacity. The IEPA revised the water quality standards in Illinois which resulted in lower treatment plant effluent limits for ammonia-nitrogen and phosphorus at Illinois POTWs. The Authority received a new NPDES permit in September of 2015 which included a 1.0 mg/L monthly average phosphorus limit. This permit is included as Appendix B.



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SECTION 9
CAPITAL IMPROVEMENTS PLAN
(10-YEAR ASSESSMENT)

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9. CAPITAL IMPROVEMENTS PLAN (10-YEAR ASSESSMENT)

9.1 GENERAL

The Authority is responsible for providing sanitary service and treatment for the communities within the Facility Planning Area. The preceding sections have described the Facility Planning Area, the current and future capacity needs, the existing wastewater treatment facility, and pending regulatory requirements. As the designated management agency, the Authority is also responsible for meeting the long-range goals of the Clean Water Act and to minimize the environmental impacts of pollution from the sanitary waste generated within the Facility Planning Area.

The Glenbard Advanced Wastewater Treatment Facility was originally constructed in 1977 as an expansion to the existing plant owned by Glen Ellyn. The facility has been incrementally expanded and rehabilitated over the past 41 years, and as such much of the plant buildings and equipment date back to this period. In general, concrete structures have a service life of up to 75 years, however equipment varies depending on use, maintenance, and manufacturer. High-speed equipment such as pumps can be expected to provide 12-15 years of service life, and low-speed process equipment such as screens and belt presses provide 20-25 years. These are diminished in corrosive or abrasive applications such as raw sewage handling or grit removal.

A significant amount of the equipment at the GAWTF has reached or has exceeded its respective service life. Diligent maintenance and operation have provided the Authority with exceptional equipment longevity, however several major systems will require replacement within the next 10 years. This includes the primary clarifiers, biological process, intermediate clarifiers and pump station, final clarifiers, and dewatering systems. The bulk of this equipment was installed in the 1977 expansion and is due for replacement.

Recommendations for rehabilitation and replacement have been separated into two groups; those budgeted through annual small projects funding, and Capital Improvements Projects. Incorporating a number of items requiring replacement into a single capital project provides cost efficiencies in the form of scales of economy and consolidating contractor's administrative costs. Annual replacement program items will be limited to a probable cost of approximately $500,000. Larger capital projects will be further reviewed to identify the funding mechanisms available – local funding, SRF loans, bonds, or other sources.

9.2 RECOMMENDATIONS

9.2.1 Annual Small Projects Rehabilitation

A condition assessment for each piece of major equipment within the Plant was completed. This included field analysis, staff evaluation, and service life estimates to determine the anticipated replacement year. Items which are not scheduled for replacement within a major capital improvement project were prioritized for replacement over the next 10 years, to be financed through the annual equipment replacement funds. With an annual funding allotment of approximately $300,000-$600,000 per year for equipment replacement was prioritized beginning in FY2020 as follows:

CY2020: RAS Pump Station Rehabilitation	($180,000)
CY2021: Grit Pump & Screening Washer/Conveyor Replacement	($310,000)
CY2022: Gravity Sludge Thickener Rehabilitation	($560,000)
CY2023: Carbo RAS Pump Replacement	($240,000)
CY2024: RAS Mag Meter Replacement	($60,000)
CY2025: Grit Washer #1 and Meter Replacement	($225,000)
CY2026: Grit Washer #2 and Effluent Meter Replacement	($225,000)
CY2027: Carbo RAS Meter & RAS VFD Replacement	($210,000)
CY2028: Grit Removal Chamber #1 Replacement	($225,000)
CY2029: Grit Removal Chamber #2 & Blower Replacement	($345,000)

**Each year there is an anticipated additional $100,000 to be spent on the Unox Deck for replacement of motors, drives, mixers, etc. over the next ten years.*

The condition assessments are provided in Appendix D, as well as being shown on the following pages. The table is organized by plant process, with replacement years identified in either red (beyond service life), yellow (nearing service life), or green (appreciable remaining service life).

It should be noted that all rehabilitation cost estimates are in 2018 dollars. The Engineering News-Record compiles historical Construction Cost Indices (CCI) which can be utilized to project future costs given recent trends in construction cost inflation. The 10-year CCI average is 2.92% and can be used to project future projects. For example, the FY2027 CSO Facility Upgrades is estimated at $2,300,000 in 2018 dollars, however this would equate to $2,300,000 x (1.0292 ^ 10) = $3,067,000 in 2028 dollars. Therefore, the Authority should adjust annual rehabilitation funding each year to match the CCI to allow for increasing construction costs and to maintain the rehabilitation and replacement schedule. The full condition assessment table included in Appendix D lists the year-adjusted total funding requirement.

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Bar Screen Building						
Mechanical Bar Screen #1	Headworks	Mahr	Good	2007	25	2032
Mechanical Bar Screen #2	Headworks	Mahr	Good	2007	25	2032
Washer	Lakeside	-	Poor	2006	20	2026
Conveyor	Hycor	-	Poor	1998	20	2018
Raw Sewage Pump Station						
Raw Sewage Pump #1	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #2	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #3	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #1	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #2	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #3	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #1	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #2	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #3	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Wet Well Drain Pump	Gorman Rupp	-	Currently Being Replaced	2018	25	2043
Grit Building						
Vortex Grit Washer #1	Huber	-	Good	2005	20	2025
Vortex Grit Washer #2	Huber	-	Good	2005	20	2025
Aeration Blower #1	Lamson	Turbotron	Fair	2009	20	2029
Aeration Blower #2	Lamson	Turbotron	Fair	2009	20	2029
Mag Meter - Raw Flows - 36"	ABB		Fair	2011	20	2031
Grit Pump #1	Morris	-	Good	2005	15	2020
Grit Pump #2	Morris	-	Good	2005	15	2020
Grit Removal Chamber #1	Smith & Loveless	PISTA	Fair	2005	20	2025
Grit Removal Chamber #2	Smith & Loveless	PISTA	Fair	2005	20	2025
Grit Blower Flow Meter	-	-	-	2005	20	2025
Grit Blower Flow Meter	-	-	-	2005	20	2025
Primary Clarifiers						
Primary Clarifier #1 Collector	Eimco	-	Fair	1977	30	2007
Primary Clarifier #1 Drive	Westec	-	Fair	1999	15	2014
Primary Clarifier #1 Motor	Eimco	-	Fair	1977	15	1992
Primary Clarifier #2 Collector	Eimco	-	Fair	1977	30	2007
Primary Clarifier #2 Drive	Westec	-	Fair	2004	15	2019
Primary Clarifier #2 Motor	Eimco	-	Fair	1977	15	1992
Primary Sludge						
Primary Sludge Pump #1	Moyno	-	Fair	2007	15	2022
Primary Sludge Pump #2	Moyno	-	Fair	2007	15	2022
Primary Sludge Grinder #1	JWC	Muffin Monster	Fair	2007	15	2022
Primary Sludge Grinder #2	JWC	Muffin Monster	Fair	2007	15	2022
Scum Pump #1	Yeomans Pump	SDV Series 4000	Fair	2007	15	2022
Scum Pump #2	Yeomans Pump	SDV Series 4000	Fair	2007	15	2022
Air Compressor #1	Gardner Denver	-	Fair/Poor	2007	10	2017
Air Compressor #2	Gardner Denver	-	Fair/Poor	2007	10	2017
Primary Sludge Mag Meter - 10"	-	-	Poor	2010	20	2030
Primary Sludge Mag Meter - 10"	-	-	Poor	2010	20	2030
Cabo Mag Meter - 24"	ABB	-	Poor	2014	10	2024
Nitro Mag Meter - 24"	ABB	-	Poor	2014	10	2024
Primary Scum Concentrator/Compactor	Lakeside	-	Good	2010	20	2030
Scum Wash Water Pump	-	-	Good	2010	15	2025

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
UNOX System						
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #1	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #2	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #3	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #4	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #5	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #6	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #7	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #8	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #9	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #10	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #11	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #12	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #13	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #14	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #15	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #16	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #17	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #18	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #19	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #20	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #21	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #22	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #23	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #24	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #25	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #26	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #27	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #28	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #29	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #1	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #2	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #3	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #4	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #5	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #6	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #7	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #8	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #9	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #1	Union Carbide, Unox System	-	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #2	Union Carbide, Unox System	-	Fair	1977	25	2002

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Pure Ox Supply Valve & Operator - 6" #1	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #2	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #3	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #4	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #5	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #6	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #7	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #8	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #9	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #10	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #1	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #2	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #3	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #4	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #5	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #6	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #7	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #8	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #9	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #10	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #1	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #2	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #3	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #4	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #5	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #6	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #7	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Purge Blower #1	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #2	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #3	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #4	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #5	Siemens-Allis	-	Poor	1977	30	2007
Intermediate Clarifiers						
Intermediate Clarifier #1 Collector	Walker	-	Fair	1969	30	1999
Intermediate Clarifier #1 Drive	Westec	-	Fair	2007	15	2022
Intermediate Clarifier #1 Motor	Walker	-	Fair	1969	15	1984
Intermediate Clarifier #2 Collector	Walker	-	Fair	1977	30	2007
Intermediate Clarifier #2 Drive	Westec	-	Fair	1999	15	2014
Intermediate Clarifier #2 Motor	Walker	-	Fair	1977	15	1992
Telescoping Valves (6)	-	-	Poor	1977/2003	15	1999

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Carbonaceous Return Activated Sludge						
Carbo Wasting Pump #1	ABS	XFP 80C CB1	Good	2015	20	2035
Carbo Ras Return Flow Meter/Parshall Flume #1	-	-	Good/Fair	1977	50	2027
Carbo Ras Return Flow Meter/Parshall Flume #2	-	-	Good/Fair	1977	50	2027
Carbo RAS Pump #1	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #2	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #3	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #4	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Intermediate Pump Station						
Intermediate Screw Pump #1	Lakeside	84" Archimedes Screw	Good	2014	30	2044
Intermediate Screw Pump #2	Lakeside	84" Archimedes Screw	Fair/Poor	1977	30	2007
Intermediate Screw Pump #3	Lakeside	84" Archimedes Screw	Fair/Poor	1977	30	2007
Pump #1 Lower Bearing	Lakeside	-	Good	2014	10	2024
Pump #2 Lower Bearing	Lakeside	-	Fair	2005	10	2015
Pump #3 Lower Bearing	Lakeside	-	Fair	2005	10	2015
Pump #1 Upper Bearing	Lakeside	-	Good	2014	10	2024
Pump #2 Upper Bearing	Lakeside	-	Good	2011	10	2021
Pump #3 Upper Bearing	Lakeside	-	Good	2011	10	2021
Final Clarifiers						
Final Clarifier #1 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #1 Drive	Westec	-	Good	1999	15	2014
Final Clarifier #1 Motor	-	-	Fair	1977	15	1992
Final Clarifier #1 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #2 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #2 Drive	Westec	-	Good	2001	15	2016
Final Clarifier #2 Motor	-	-	Fair	1977	15	1992
Final Clarifier #2 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #3 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #3 Drive	Westec	-	Good	2002	15	2017
Final Clarifier #3 Motor	-	-	Fair	1977	15	1992
Final Clarifier #3 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #4 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #4 Drive	Westec	-	Good	2002	15	2017
Final Clarifier #4 Motor	-	-	Fair	1977	15	1992
Final Clarifier #4 Launder Covers	Nefco	-	Good	2017	20	2037

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Sludge Pump Station						
Nitro WAS Pump #1	Shanley Pump	SED 560 1 H311P11	Fair	2004	20	2024
Nitro WAS Pump #2	Shanley Pump	SED 560 1 H311P12	Fair	2004	20	2024
Final Clarifier RAS Waste Pump VFD #1	-	-	Fair	2009	15	2024
Final Clarifier RAS Waste Pump VFD #2	-	-	Fair	2009	15	2024
Nitro Mag Meter - 4"	-	-	Replace	2003	20	2023
Carbo Mag Meter - 4"	-	-	Replace	2003	20	2023
Thickener Refresh Water Mag Meter - 3"	-	-	Replace	2003	20	2023
Final Clarifier RAS Mag Meter - 10" #1	ABB Fischer & Porter	10DX3111EDE19P	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10" #2	ABB Fischer & Porter	1A2HKZ1321	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10" #3	ABB Fischer & Porter	10DX3111EDE19P	Fair	2010	20	2030
Final Clarifier RAS Mag Meter - 10" #4	ABB Fischer & Porter	1A2HKZ1321	Fair	2010	20	2030
Thickened Sludge Pump	Moyno	1G175G1 CDQ 35AA	Good	2010	15	2025
Thickened Sludge Pump	Moyno	1G175G1 CDQ 35AA	Good	2010	15	2025
RAS Control Valve - 18" #1	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #2	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #3	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #4	Limitorque MX	-	Good	1977	15	1992
Thickened Sludge Mag Meter - 4" #1	ABB Fischer & Porter	-	Fair	2010	20	2030
Thickened Sludge Mag Meter - 4" #2	ABB Fischer & Porter	-	Fair	2003	20	2023
Tertiary Treatment Building						
Disc Filter No. 1	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 2	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 3	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 4	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 5	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 6	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disinfection Building						
UV Disinfection Unit #1	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #2	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #3	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #4	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #5	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #6	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #7	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #8	Fischer & Porter	-	Good	2017	20	2037
Non-Pot Pump #1	Grundfos	-	Good	2010	20	2030
Non-Pot Pump #2	Grundfos	-	Good	2010	20	2030
Non-Pot Pump #3	Grundfos	-	Good	2010	20	2030
Final Effluent Flow Meter	-	-	Fair	2006	20	2026

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Gravity Sludge Thickener						
Gravity Sludge Thickener Cover	-	-	Fair	1977	30	2007
Gravity Sludge Thickener Collector	-	-	Fair	1977	30	2007
Gravity Sludge Thickener Drive	Westec	-	Fair	1999	15	2014
Gravity Sludge Thickener Motor	-	-	Fair	1977	15	1992
Anaerobic Digesters						
Anaerobic Digester Cover #1	Walker Process	-	Good	2010	25	2035
Anaerobic Digester Cover #2	Walker Process	-	Good	2010	25	2035
Anaerobic Digester Cover #3	Walker Process	-	Good	2010	25	2035
Waste Gas Burner	Varec Biogas	-	Good	2010	25	2035
Anaerobic Digester Boiler #1	US Filter	-	Good	2010	25	2035
Anaerobic Digester Boiler #2	US Filter	-	Good	2010	25	2035
Anaerobic Digester Mixing Pump #1	Vaughan	V00641	Good	2010	20	2030
Anaerobic Digester Mixing Pump #2	Vaughan	V00580	Good	2010	20	2030
Anaerobic Digester Mixing Pump #3	Vaughan	V00641	Good	2010	20	2030
Anaerobic Digester Mixing Pump #4	Vaughan	V00580	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #1	Moyno	-	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #2	Moyno	-	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #3	Moyno	-	Good	2010	20	2030
Sludge Grinder #1	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #2	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #3	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #4	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #5	JWC	Muffin Monster	Good	2010	20	2030
Belt Filter Press Feed Pump #1	Moyno	-	Good	2010	20	2030
Belt Filter Press Feed Pump #2	Moyno	-	Good	2010	20	2030
Digester Transfer Pump #1	Wemco-Hidrostal	E4K-S-E25M	Good	2010	20	2030
Digester Transfer Pump #2	Wemco-Hidrostal	E4K-S-E25M	Good	2010	20	2030
Sludge Thickening/Dewatering						
Gravity Belt Thickener	Ashbrook	Aquabelt	Not in Use	2003	20	2023
Polymer Mixing Unit #1	Norchem Industries	ACDU120/530W3H	Good	2018	15	2033
Polymer Mixing Unit #2	Norchem Industries	ACDU120/530W3H	Good	2018	15	2033
Belt Filter Press #1	Ashbrook-Simon-Hartley	Klampress	Fair	1991	20	2011
Belt Filter Press #2	Ashbrook-Simon-Hartley	Klampress	Fair	1991	20	2011
Polymer Transfer Pump #1	Moyno Pumps	-	Good	2003	15	2018
Polymer Transfer Pump #2	Moyno Pumps	-	Good	2003	15	2018
Polymer Transfer Pump #3	Moyno Pumps	-	Good	2003	15	2018
Polymer Day Tanks #1	Snyder Ind.	ASM TK 500VOT x48TDHD/NAT	Good	2003	30	2033
Polymer Day Tanks #2	Snyder Ind.	ASM TK 500VOT x48TDHD/NAT	Good	2003	30	2033

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Generator Building						
Switchgear Battery Array	-	-	Good	1995	35	2030
Generator #1	Caterpillar	-	Good	1995	35	2030
Generator #2	Caterpillar	-	Good	1995	35	2030
Generator #3	Caterpillar	-	Good	1995	35	2030
Natural Gas Generator #1	Caterpillar	G3516	Good	1995	35	2030
Natural Gas Generator #2	Caterpillar	G3516	Good	1995	35	2030
Natural Gas Generator #3	Caterpillar	G3516	Good	1995	35	2030
Radiator Drive Motor #1	-	-	Good	1995	35	2030
Radiator Drive Motor #2	-	-	Good	1995	35	2030
Radiator Drive Motor #3	-	-	Good	1995	35	2030
Radiator Drive Motor #4	-	-	Good	1995	35	2030
Radiator Drive Motor #5	-	-	Good	1995	35	2030
Radiator Drive Motor #6	-	-	Good	1995	35	2030
Aftercooler #1	-	-	Good	1995	35	2030
Aftercooler #2	-	-	Good	1995	35	2030
Aftercooler #3	-	-	Good	1995	35	2030
Co-Gen System Boost Transformer	S&C	-	Good	1995	35	2030
Cryo Plant - Not In Service						
Nitrification Basins - Not In Service						
Backwash Holding Tank - Not In Service						

9.2.2 Capital Improvements Projects

Twelve capital projects have been identified for completion within the 10-year capital improvements program. As previously discussed, the majority of the GAWTF was constructed in 1977 and as such the equipment installed in this era has reached the end of their useful service lives. The Authority will need to plan for replacement of a number of major processes over the next 10-15 years. In addition, regulatory requirements for phosphorus and nitrogen removal will necessitate major improvements to the biological process unrelated to rehabilitation. In process order, the capital projects identified include:

Project	Construction Subtotal w/ 15% Contingency	Engineering, Legal & Admin @ 15%	Total
1. Primary Clarifier Rehabilitation:	$1,778,000	$267,000	$2,045,000
2. Grit/Primary Clarifier Odor Control (Phase 1):	$384,000	$60,000	$444,000
3. Grit/Primary Clarifier Odor Control (Phase 2):	$992,000	$149,000	$1,141,000
4. Sludge Thickening Odor Control (Phase 1):	$303,000	$45,000	$348,000
5. Sludge Thickening Odor Control (Phase 2):	$1,100,000	$159,000	$1,259,000
6. Electronic O&M Manuals:	N/A	$380,000	$380,000
7. Sludge Dewatering Rehabilitation:	$1,900,000	$280,000	$2,180,000
8. Intermediate Pumping Station Rehabilitation:	$1,600,000	$242,000	$1,842,000
9. Intermediate Clarifier Rehabilitation:	$1,010,000	$162,000	$1,172,000
10. Chemical Phosphorus Removal (1.0 mg/L):	$2,000,000	$293,000	$2,293,000
11. Final Clarifier Rehabilitation:	$4,200,000	$625,000	$4,825,000
12. CSO Facility Upgrades:	$2,010,000	$308,000	$2,308,000
		Total Capital Projects:	**$20,237,000**

Each of these projects, as well as alternatives evaluated, are described in detail in the respective unit process reviews within Section 5. Detailed cost estimates including scope of work to be completed are included in Appendix E.

Implementation Plan

The implementation schedule for capital improvements is driven by both urgency of rehabilitation needs, and regulatory requirements imposed by the Illinois EPA.

	Implementation Plan ($ in Millions)										
Project Description	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029(1)**	**Project Total**
Primary Clarifier Rehabilitation	2.10										**2.10**
Grit Building/Primary Clarifier Odor Control (Phase 1)		0.45									**0.45**
Grit Building/Primary Clarifier Odor Control (Phase 2)			1.20								**1.20**
Sludge Thickening Odor Control (Phase 1)		0.35									**0.35**
Sludge Thickening Odor Control (Phase 2)			1.22								**1.22**
Electronic O&M Manuals				0.38							**0.38**
Sludge Dewatering Rehabilitation		2.20									**2.20**
Intermediate Pumping Station Rehabilitation					1.90						**1.90**
Intermediate Clarifier Rehabilitation						1.20					**1.20**
Chemical Phosphorus Removal (1.0 mg/L)				2.30							**2.30**
Final Clarifier Rehabilitation							4.80				**4.80**
CSO Facility Upgrades								2.30			**2.30**
Various Small-Scale (From Condition Assessment Table)	0.30	0.42	0.63	0.31	0.13	0.30	0.30	0.32	0.33	0.45	**3.48**
PLC Replacement Projects	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	**1.30**
MCC Replacement Projects	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	**1.40**
Annual Collection System Rehabilitation Funding	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	**3.00**
Annual Lift Station Rehabilitation Funding	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	**2.30**
Calendar Year Total:	**3.20**	**4.22**	**3.85**	**3.79**	**2.83**	**2.30**	**5.90**	**3.42**	**1.13**	**1.25**	***31.88***
(1): Future Capital Project for TN Removal (Estimated at $27.7 Million - 2018 dollars) Est. Year 2030-2035											

9.3 CAPITAL FUNDING AND ALTERNATIVE FUNDING SOURCES

The Authority has several different funding options available in order to successfully fund the outlined projects. Some of the different funding options include local funding, Illinois EPA Low-Interest Loan State Revolving Fund (SRF), Bonds, and Grants. Additionally, there have been discussions at both the State and Federal level in regards to Capital Infrastructure Bills. The details of these bills is largely unknown at this point, but may include low or zero interest rate loans and/or loan forgiveness.

9.3.1 Illinois EPA Low-Interest Loan State Revolving Fund (SRF)

The IEPA State Revolving Fund is a program that has been developed as a part of the Illinois Clean Water initiative (CWI). It is this initiative that maintains the Water Pollution Control Loan Program (WPCLP) which funds both wastewater and stormwater projects, and has been doing so since the late 1980's. Each year, this program receives Federal Capital Funding which is matched with State Funds, interest earning, repayment money, and the sale of bonds. It is these funding mechanisms that are utilized by the State to form a continuous source of financing for the wastewater and stormwater projects.

The Illinois EPA Low-Interest Loan program was developed to provide financial assistance to both the public and private applications for design and construction of projects that protect or improve the quality of Illinois' water resources. In the past few years, the State has annually funded around $300-400 Million with projects at interest rates ranging from 1.75-2.21%.

A specific application process has been developed to obtain SRF funding, and requires a project nomination form, as well as planning approval of a project plan or facility plan for the community pursuing funding. The project planning report can be submitted anytime throughout the year, however an annual renewal of funding nomination forms should be sent into the State by January 31st of each year. Once a community has an approved project plan, additional documentation including a loan application is completed with a financial checklist. Once the project has been bid, a final loan agreement is executed.

Each year the loan rate is established on July 1st, and a typical loan is written around a 20-year term. However, the state has recently developed additional programs to provide reduced interest rates for "small communities", and "hardship rates". Reduction of rates can also come from specific design considerations that reduce impacts on the environment and reduce the overall energy footprint of the wastewater treatment plant. This reduction can equate to a reduction of 0.2% off the base interest rate.

9.3.2 Grants

The Authority many be eligible to receive grant funding from several different sources, including the Department of Commerce and Economic Opportunity (DCEO), ComEd, as well as the USEPA. Each program is appropriated funds from U.S. Congress in January, and funds begin to be administered by each state in early spring. Each state receives a different allocation of funds depending on several factors that evaluate the total need. Therefore, a state in greater need of funds will be appropriated a larger quantity of funding.

Each of the different grant funding sources have numerous grants available. Typically, in both cases the grants that are obtained are tied to economic need, as well as an attempt to bring jobs and/or resources to the community. A grant that is provided to a community is typically less than $500,000, and is also matched by the community. Therefore, a project that receives a $200,000 grant, the Community would fund $200,000 as well, equating to a total project cost of $400,000.

Due to the income of neighborhoods within the FPA, it is unlikely that the GWA would qualify for the need-based grant programs. The most applicable grant for communities such as Glen Ellyn and Lombard are energy grants, currently administered by Commonwealth Edison. Many communities have previously used these grants for replacement of aging centrifugal or positive displacement blowers with more efficient turbo or hybrid blowers. Due to the unique nature of the TS-HPOAS system, proving energy efficiencies in the biological process over hauling O_2 would be difficult.

9.3.3 Bonds

Bonds can be broken down into several different categories including General Obligation Bonds, Revenue bonds, and Tax Increment Financing District Funding.

General Obligation Bonds (GO)

A general obligation bond (GO) is secured through taxable property within a community, and is a municipal bond that is backed by the credit and taxing power of the issuing jurisdiction. A GO bond is not issued against the revenue from a project or development. Therefore, the value of the bond is held completely against the asset value and not the amount of the utility consumed. Typically, a general obligation bond has lower interest rates as there is less risk of default, and are generally used to fund projects that will serve the community, such as roads, parks, equipment, and bridges.

Revenue Bonds

A revenue bond is supported and funded by the revenue of a specific project, and/or user charge revenues. Typically, holders of revenue bonds can only rely on the specific project's income, has higher risk and pays a higher interest rate. Revenue bonds are issued in blocks of time that typically fully mature within 20 to 30 years. One disadvantage of the revenue bond is that there is inherent concern that the bond ordinance requires the establishment of reserve funds to cover the risk of revenues falling short of the retirement requirement, and this burden falls onto the users of the utility or product being purchased.

9.3.4 Tax Increment Financing District Funding (TIF)

A TIF district is formed within a specific boundary within the facility planning area or municipal boundary within the community. This TIF district is used to create and dedicate a source of revenue that can be used to fund and retire debt within a specific area. Typically this type of bonding is done within an area that doesn't have infrastructure or services. A TIF district is created prior to the development of a property and the value of the bond is set prior to the start of work. However, there is the option to add additional projects to a TIF district if it is proven that the district can withstand the added debt, the required revenues to payback the deficit, as well as sufficient time to pay it back.

The Tax Increment Allocation Redevelopment Act (TIF Act) in 1977, changed the TIF requirements and provided the ability of municipalities the power and authority to address the adverse conditions and conservation of areas within their planning areas. Municipalities are able to take redevelopment projects that were essential to the economic well-being of the community.

9.3.5 Capital Infrastructure Bills

In October of 2018, S.3021 "America's Water Infrastructure Act of 2018" was passed by Congress and signed into law. This Act combines the biennial Water Resources Development Act (WRDA) and the reauthorization of the Water Infrastructure Financing and Innovation Act (WIFIA). The law will double grants to states for the Drinking Water Revolving Loan Fund and reauthorizes the WIFIA program. While substantial, the funding outlined to date is not tailored to wastewater infrastructure. WIFIA is primarily a large-scale program with a minimum project size of $20M for large communities (population over 25,000). The Act does allocate $225M annually for improvements reducing sanitary sewer overflows (SSO), or stormwater reuse. The details of the allocation are not yet known at the time of this report, however the Authority should continue to monitor this program as it relates to the collection system.

Additionally, there have been a number of discussions at the State level regarding a Capital Infrastructure Bill utilizing revenue generated through an increase in the motor fuel tax (MFT). When funded through an MFT program, the recipients of funding are typically roadways, bridges, and other civil improvements. However, there may be funding designated for wastewater projects. A bill has not yet been drafted, but it is anticipated that one may take shape over the next six months. The Authority should also continue to monitor the progress of this act, specifically with projects that may be considered "shovel ready" in 2019.

APPENDIX A
CUSTOMER CORRESPONDENCE LOG

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Work Product Privilege.

Tracking # ____________

Customer Correspondence Log

Plant & Maintenance Operations

General

Date Received:	Time Received: AM/PM
Customer Name:	Received By:
Customer Address:	Phone:

Details

Nature of Correspondence: ☐ Odor ☐ Noise ☐ Sewer Backup ☐ Other

Location if different from Customer's address (address, cross streets, landmarks, etc.):
"Where were you when you smelled the odor/heard the noise?"

Date:	Time: AM/PM	Duration: hours minutes

Odor Intensity Scale	1	2	3	4	5	6	7	8
	☐	☐	☐	☐	☐	☐	☐	☐
	Very faint		Light		Moderate		Very Strong	

Odor Description:
- ☐ Rotting Cabbage ☐ Sour ☐ Manure/Farmyard ☐ Ammonia
- ☐ Sewer/Sewage Like ☐ Earthy/Musty ☐ Sweet Fragrance ☐ Chemical/Solvent
- ☐ Rotten Egg/Sulphur ☐ Bleach/Chlorine ☐ Other ______________________

Weather Conditions:
- Temperature ________
- Wind Direction ________
- Wind Speed: ☐ Calm ☐ Moderate Wind (5-15 mph) ☐ Light Breeze (1-5 mph) ☐ Strong Wind (15+ mph)

Comments:

Operator Signature:

Field Inspection (For Internal Use Only)

Assigned To:	Date:	Time: AM/PM

Weather Conditions: Temperature ________ Wind Speed ________ Wind Direction ________ Humidity ________

Conditions Found/Remarks (odor/noise description & intensity):

Possible cause based on your inspection:

Action taken:

Date/Time Inspection Began:	Date/Time Inspection Ended:

Response to Customer

Was Customer contacted?: ☐YES ☐NO	Date:	Time: AM/PM

Comments:

Management Signature:

APPENDIX B
NPDES PERMIT

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

BRUCE RAUNER, GOVERNOR LISA BONNETT, DIRECTOR

217/782-0610

September 23, 2015

SEP 25 2015

Glenbard Wastewater Authority
21 W. 551 Bemis Road
Glen Ellyn, Illinois 60137

Re: Glenbard Wastewater Authority - Main WWTP
NPDES Permit No. IL0021547
Final Permit

Gentlemen:

Attached is the final NPDES Permit for your discharge. The Permit as issued covers discharge limitations, monitoring, and reporting requirements. Failure to meet any portion of the Permit could result in civil and/or criminal penalties. The Illinois Environmental Protection Agency is ready and willing to assist you in interpreting any of the conditions of the Permit as they relate specifically to your discharge.

The Agency has begun a program allowing the submittal of electronic Discharge Monitoring Reports (NetDMRs) instead of paper Discharge Monitoring Reports (DMRs). If you are interested in NetDMRs, more information can be found on the Agency website, http://epa.state.il.us/water/net-dmr/index.html. If your facility is not registered in the NetDMR program, a supply of preprinted paper DMR Forms for your facility will be sent to you prior to the initiation of DMR reporting under the reissued permit. Additional information and instructions will accompany the preprinted DMRs upon their arrival.

The attached Permit is effective as of the date indicated on the first page of the Permit. Until the effective date of any re-issued Permit, the limitations and conditions of the previously-issued Permit remain in full effect. You have the right to appeal any condition of the Permit to the Illinois Pollution Control Board within a 35 day period following the issuance date.

Should you have questions concerning the Permit, please contact Francis Barba at 217/782-0610.

Sincerely,

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:FRB:12041102.bah

Attachment: Final Permit

cc: Records
Compliance Assurance Section
Des Plaines Region
Billing
CMAP
Baxter & Woodman, Inc.
USEPA
DuPage River Salt Creek Workgroup

NPDES Permit No. IL0021547

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

Reissued (NPDES) Permit

Expiration Date: August 31, 2020

Issue Date: September 23, 2015
Effective Date: September 23, 2015

Name and Address of Permittee:

Glenbard Wastewater Authority
21 W. 551 Bemis Road
Glen Ellyn, Illinois 60137

Facility Name and Address:

Glenbard Wastewater Authority - Main WWTP
21 W. 551 Bemis Road
Glen Ellyn, Illinois 60137
(DuPage County)

Receiving Waters: East Branch DuPage River

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 standard conditions and attachments 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.

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:FRB:12041102.bah

NPDES Permit No. IL0021547

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 STP Outfall

Load limits computed based on a design average flow (DAF) of 16.02 MGD (design maximum flow (DMF) of 47.0 MGD).

From the effective 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:

	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	
$CBOD_5$**,*****	1336 (3920)		2672 (7840)	10		20	2 Days/Week	Composite
Suspended Solids****	1603 (4704)		3207 (9408)	12		24	2 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						2 Days/Week	Grab
Fecal Coliform***	Daily Maximum shall not exceed 400 per 100 mL (May through October)						2 Days/Week	Grab
Ammonia Nitrogen: as (N)[2] April-October.	200 (588)		401 (1176)	1.5		3.0	2 Days/Week	Composite
Nov.-Feb.	441 (1294)		1002 (2940)	3.3		7.5	2 Days/Week	Composite
March	334 (980)	842 (2469)	1657 (4861)	2.5	6.3	12.4	2 Days/Week	Composite
Total Phosphorus (as P)[1]	134 (392)			1.0			1 Day/Week	Composite
Total Nitrogen	Monitor only						1 Day/Month	Composite
Dissolved Phosphorus	Monitor only						1 Day/Month	Composite
Nitrate/Nitrite	Monitor only						1 Day/Month	Composite
Total Kjeldahl Nitrogen (TKN)	Monitor only						1 Day/Month	Composite
Alkalinity	Monitor only						1 Day/Month	Grab
Temperature	Monitor only						1 Day/Month	Grab
Chloride	Monitor only						1 Day/Month	Grab
				Monthly Average not less than	Weekly Average not less than	Daily Minimum		
Dissolved Oxygen March-July				N/A	6.0	5.0	2 Days/Week	Grab
August-Feb.				5.5	4.0	3.5	2 Days/Week	Grab

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

NPDES Permit No. IL0021547

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 STP Outfall (continued)

**Carbonaceous BOD_5 ($CBOD_5$) testing shall be in accordance with 40 CFR 136

***See Special Condition 9.
****See Special Condition 19.
[1] See Special Condition 17.
[2] 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 daily maximum value.
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 Phosphorus shall be reported on the DMR as a daily maximum and monthly average value.

Influent Monitoring, and Reporting

The influent to the plant shall be monitored as follows:

Parameter	Sample Frequency	Sample Type
Flow (MGD)	Continuous	
BOD_5	2 Days/Week	Composite
Suspended Solids	2 Days/Week	Composite
Total Phosphorus (as P)	1 Day/Month	Composite
Total Nitrogen	1 Day/Month	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 and Total Nitrogen shall be reported on the DMR as a maximum value.

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. The Permittee shall record monitoring results on Discharge Monitoring Report (DMR) 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 may choose to submit electronic DMRs (NetDMRs) instead of mailing paper DMRs to the IEPA. More information, including registration information for the NetDMR program, can be obtained on the IEPA website, http://www.epa.state.il.us/water/net-dmr/index.html.

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 not using NetDMRs 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 7. The provisions of 40 CFR Section 122.41(m) & (n) are incorporated herein by reference.

SPECIAL CONDITION 8. 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 9. Fecal Coliform limits for Discharge Number 001 are effective May thru October. Sampling of Fecal Coliform is only required during this time period.

Any use of chlorine to control slime growths, odors or as an operational control, etc. shall not exceed the limit of 0.05 mg/L (daily maximum) total residual chlorine in the effluent. Sampling is required on a daily grab basis during the chlorination process. Reporting shall be submitted on the DMR's on a monthly basis.

SPECIAL CONDITION 10.

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 February 4, 1988 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

Special Conditions

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 levels 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).

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 pollutant(s) which cause pass through or interference and the introduction of specific pollutants to the waste treatment system from <u>any</u> source of nondomestic discharge.

4. In addition to the general limitations expressed in Paragraph 3 above, applicable pretreatment standards must be met by <u>all industrial users</u> 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.

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 <u>one (1) year</u> 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: <u>http://cfpub.epa.gov/npdes/whatsnew.cfm?program_id=3</u>. This includes any necessary revisions to the Permittee's Enforcement Response Plan (ERP).

8. Within twenty-four (24) months from the effective date of this permit, the Permittee shall conduct a technical re-evaluation of its local limitations consistent with U.S. EPA's Local Limits Development Guidance (July 2004), and submit the evaluation and any proposed revisions to its local limits to IEPA and U.S. EPA Region 5 for review and approval. USEPA Region 5 will request Permittee to submit the evaluation and any proposed revisions to its local limits on the spreadsheet found at <u>http://www.epa.gov/region5/water/npdestek/Locallmt.XLS</u>. 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

Special Conditions

•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. The Permittee's Pretreatment Program has been modified to incorporate a Pretreatment Program Amendment approved by USEPA on October 1, 1996. The amendment became effective on the date of approval and is a fully enforceable provision of your Pretreatment Program.

Modifications of your Pretreatment Program shall be submitted in accordance with 40 CFR § 403.18, which established conditions for substantial and nonsubstantial modifications. All requests should be sent in electronic format to r5npdes@epa.gov, attention: NPDES Programs 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 no later than April 28 of each year in electronic format to r5pretreatment@epa.gov, attention Water Enforcement and Compliance Assurance Branch or in written format to USEPA, Region 5, 77 West Jackson Blvd., Chicago, Illinois 60604, Attention: Water Enforcement and Compliance Assurance Branch, 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).

Special Conditions

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 monitoring report forms provided by the IEPA and include them in its annual report. Samples shall be taken at quarterly 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 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
00722	Cyanide(grab)* (available**** or amenable to chlorination)	5.0 ug/L
00720	Cyanide (total) (grab)	5.0 ug/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

Minimum reporting limits are defined as – (1) The minimum value below which data are documented as non-detects. (2) Three to ten times the method detection limit. (3) The minimum value of the calibration range.

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

* Influent and effluent only
**1 ng/L = 1 part per trillion.
***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.
****USEPA Method OIA – 1677.

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.

Special Conditions

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 shall be 24-hour composites.

      Five (5) grab samples shall be collected each monitoring day to be analyzed for volatile organic compounds. A single analysis for volatile pollutants (Method 624) may be run for each monitoring day by compositing equal volumes of each grab sample directly in the GC purge and trap apparatus in the laboratory, with no less than one (1) mL of each grab included in the composite.

      Wastewater samples must be handled, prepared, and analyzed by GC/MS in accordance with USEPA Methods 624 and 625 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 624 and 625 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.

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 treatment program elements should be submitted in redline/strikeout electronic 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.

SPECIAL CONDITION 11. The Permittee has undergone a Monitoring Reduction review and the influent and effluent sample frequency has been reduced for parameters due to sustained compliance. The IEPA may require that the influent and effluent sampling frequency for these parameters be increased without Public Notice. This provision does not limit EPA's authority to require additional monitoring, information or studies pursuant to Section 308 of the CWA.

SPECIAL CONDITION 12. 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 on forms provided by IEPA titled "Fiscal Report Form For NPDES Permittees".

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.

Special Conditions

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 regulations governing sewagé sludge use or disposal and shall comply with all existing applicable regulations in any jurisdiction in which sewage sludge is actually used or disposed.

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" to the following address:

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

SPECIAL CONDITION 14. This Permit may be modified to include alternative or additional final effluent limitations pursuant to an approved Total Maximum Daily Load (TMDL) Study or upon completion of an alternate Water Quality Study.

SPECIAL CONDITION 15. The Permittee shall operate the facilities designed for biological nutrient removal (BNR). Monitoring for Total Nitrogen is required to document the actual total nitrogen effluent concentration. The Permittee shall monitor the effluent for total nitrogen once per month. The monitoring shall be a composite sample and the results reported as a daily maximum on the Permittee's Discharge Monitoring Forms.

SPECIAL CONDITION 16. 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. Samples must be collected in the 18th, 15th, 12th, and 9th month prior to the expiration date of this Permit.

C. Reporting - Results shall be reported according to EPA/821-R-02-012, Section 12, Report Preparation, and shall be submitted to IEPA, Bureau of Water, Compliance Assurance Section 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 test 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

Special Conditions

bioassay. Results shall be submitted to IEPA within (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 shall immediately notify IEPA in writing of the test results.

E. Toxicity Reduction Evaluation and Identification - Should the biomonitoring program identify toxicity and result in notification by IEPA, the permittee shall develop a plan for toxicity reduction evaluation and identification. The plan shall be developed and implemented in accordance with Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants, EPA/833B-99/002, and 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 within ninety (90) days following notification by the IEPA. The Permittee shall implement the plan within ninety (90) days of notification of the permittee above or other such date as is received by letter from IEPA.

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 and toxicity reduction evaluation, the IEPA may modify this Permit to include numerical limitations for specific toxic pollutants and additional whole effluent toxicity monitoring to confirm the results of the evaluation. Modifications under this condition shall follow public notice and opportunity for hearing.

SPECIAL CONDITION 17.

1. The Permittee shall participate in the DuPage River Salt Creek Workgroup (DRSCW). The Permittee shall work with other watershed members of the DRSCW to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the DRSCW watersheds.

2. The Permittee shall ensure that the following projects and activities set out in the DRSCW Implementation Plan (April 16, 2015), are completed (either by the permittee or through the DRSCW) by the schedule dates set forth below; and that the short term objectives are achieved for each by the time frames identified below:

Project Name	**Completion Date**	**Short Term Objectives**	**Long Term Objectives**
Oak Meadows Golf Course dam removal	December 31, 2016	Improve DO	Improve fish passage
Oak Meadows Golf Course stream restoration	December 31, 2017	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi
Fawell Dam Modification	December 31, 2018	Modify dam to allow fish passage	Raise fiBi upstream of structure
Spring Brook Restoration and dam removal	December 31, 2019	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Fullersburg Woods dam modification concept plan development	December 31, 2016	Identify conceptual plan for dam modification and stream restoration	Build consensus among plan stakeholders
Fullersburg Woods dam modification	December 31, 2021	Improve DO, improve aquatic habitat (QHEI)	Raise miBi and fiBi
Fullersburg Woods dam modification area stream restoration	December 31, 2022	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi

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Southern West Branch Physical Enhancement	December 31, 2022	Improve aquatic habitat (QHEI)	Raise miBi and fiBi
Southern East Branch Stream Enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
QUAL 2K East Branch and Salt Creek	December 31, 2023	Collect new baseline data and update model	Quantify improvements in watershed. Identify next round of projects for years beyond 2024.
NPS Phosphorus Feasibility Analysis	December 31, 2021	Assess NPS performance from reductions leaf litter and street sweeping	Reduce NPS contributions to lowest practical levels

3. The Permittee shall participate in implementation of a watershed Chloride Reduction Program, either directly or through the DRSCW. The program shall work to decrease DRSCW watershed public agency chloride application rates used for winter road safety, with the objective of decreasing watershed chloride loading. The Permittee shall submit an annual report on the annual implementation of the program identifying the practices deployed, chloride application rates, estimated reductions achieved, analyses of watershed chloride loads, precipitation, air temperature conditions and relative performance 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: 2015-16 winter season report shall be submitted no later than March 31, 2017). The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

4. The Permittee shall submit an annual progress report on the projects listed in the table of paragraph 2 above to the Agency by March 31 of each year. The report shall include project implementation progress. The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

5. The Permittee shall develop a written Phosphorus Discharge Optimization Plan. 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 low cost facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The permittee's evaluation shall include, but not necessarily be limited to, an evaluation of the following optimization measures:
   a. WWTF influent reduction measures.
      i. Evaluate the phosphorus reduction potential of users.
      ii. Determine which sources have the greatest opportunity for reducing phosphorus (e.g., industrial, commercial, institutional, municipal, and others).
         1. Determine whether known sources (e.g., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.
         2. Evaluate implementation of local limits on influent sources of excessive phosphorus.
   b. WWTF effluent reduction measures.
      i. Reduce phosphorus discharges by optimizing existing treatment processes without causing non-compliance with permit effluent limitations or adversely impacting stream health.
         1. Adjust the solids retention time for biological phosphorus removal.
         2. Adjust aeration rates to reduce DO and promote biological phosphorus removal.
         3. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side

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of the basin system.

4. Minimize impact on recycle streams by improving aeration within holding tanks.

5. Adjust flow through existing basins to enhance biological nutrient removal.

6. Increase volatile fatty acids for biological phosphorus removal.

6. Within 24 months of the effective date of this permit, the Permittee shall finalize the written Phosphorus Discharge Optimization Evaluation Plan and submit it to IEPA. The plan shall include a schedule for implementing all of the evaluated optimization measures that can practically be implemented and include a report that explains the basis for rejecting any measure that was deemed impractical. The schedule for implementing all practical measures shall be no longer than 36 months after the effective date of this permit. The Permittee shall implement the measures set forth in the Phosphorus Discharge Optimization Plan in accordance with the schedule set forth in that Plan. The Permittee shall modify the Plan to address any comments that it receives from IEPA and shall implement the modified plan in accordance with the schedule therein.

   Annual progress reports on the optimization of the existing treatment facilities shall be submitted to the Agency by March 31 of each year beginning 24 months from the effective date of the permit.

7. The Permittee shall, within 24 months of the effective date of this permit, complete a feasibility study that evaluates the timeframe, and construction and O & M costs of reducing phosphorus levels in its discharge to a level consistently meeting a limit of 1 mg/L, 0.5 mg/L and 0.1 mg/L utilizing a range of treatment technologies including, but not necessarily limited to, biological phosphorus removal, chemical precipitation, or a combination of the two. The study shall evaluate the construction and O & M costs of the different treatment technologies for these limits on a monthly, seasonal, and annual average basis. For each technology and each phosphorus discharge level evaluated, the study shall also evaluate the amount by which the Permittee's typical household annual sewer rates would increase if the Permittee constructed and operated the specific type of technology to achieve the specific phosphorus discharge level. Within 24 months of the effective date of this Permit, the Permittee shall submit to the Agency and the DRSCW a written report summarizing the results of the study.

8. Total phosphorus in the effluent shall be limited as follows:

   a. If the Permittee will use chemical precipitation to achieve the limit, the effluent limitation shall be 1.0 mg/L on a monthly average basis, effective 10 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 10 years of the effective date of this permit.
   b. if the Permittee will primarily use biological phosphorus removal to achieve the limit, the effluent limitation shall be 1.0 mg/L monthly average to be effective 11 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 11 years of the effective date of this permit.
   c. The Agency may modify this permit if the DRSCW has developed and implemented a trading program for POTWs in the DRSCW watersheds, providing for reallocation of allowed phosphorus loadings between two or more POTWs in the DRSCW watersheds, that delivers the same results of overall watershed phosphorus point-source reduction and loading anticipated from the uniform application of the applicable 1.0 mg/L monthly average effluent limitation among the POTW permits in the DRSCW watersheds and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.
   d. The Agency may modify this permit if the DRSCW has demonstrated and implemented an alternate means of reducing watershed phosphorus loading to a comparable result within the timeframe of the schedule of this condition and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

9. The Permittee shall monitor the wastewater effluent, consistent with the monitoring requirements on Page 2 of this permit, for total phosphorus, dissolved phosphorus, nitrate/nitrite, total Kjeldahl nitrogen (TKN), ammonia, total nitrogen (calculated), alkalinity and temperature at least once a month. The Permittee shall monitor the wastewater influent for total phosphorus and total nitrogen at least once a month. The results shall be submitted on NetDMRs to the Agency unless otherwise specified by the Agency.

10. The Permittee shall submit a Nutrient Implementation Plan (NIP) for the DRSCW watersheds that identifies phosphorus input reductions by point source discharges, non-point source discharges and other measures necessary to remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive

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aquatic algae criteria in 35 IL Adm. Code 302.203. The NIP shall also include a schedule for implementation of the phosphorus input reductions and other measures.

The Permittee may work cooperatively with the DRSCW to prepare a single NIP that is common among DRSCW permittees. The NIP shall be submitted to the Agency by December 31, 2023.

SPECIAL CONDITION 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 Ill. Adm. Code 306.304. In order to accomplish these goals of complying with this prohibition 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 occur and (B) develop, implement and submit to the IEPA a Capacity, Management, Operations, and Maintenance (CMOM) plan which includes an Asset Management strategy within twenty four (24) months of the effective date of this Permit or review and revise any existing plan accordingly. 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 were 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 back-ups occur or are likely to occur; use flow monitoring as necessary;
   5. Identification and prioritization of structural deficiencies in the system owned and operated by the Permittee;
   6. Operational control, including documented system control procedures, scheduled inspections and testing;
   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.

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. Special provisions for Pump Stations and force mains and other unique system components; and
   4. Construction plans and schedules for correction.

e. Reporting and Monitoring Requirements:

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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_bestpractices.pdf

SPECIAL CONDITION 19. BOD_5 and Suspended Solids (85% removal required) For Discharge No. 001: In accordance with 40 CFR 133, the 30-day average percent removal shall not be less than 85 percent except as provided in Sections 133.103 and 133.105. The percent removal need not be reported to the IEPA on DMRs but influent and effluent data must be 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.

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.

SPECIAL CONDITION 20. The Permittee may collect data in support of developing site-specific effluent limitations for ammonia nitrogen. Instream monitoring for pH and temperature would be required. Samples should be taken downstream at a point representative of substantial mixing with the receiving stream below the surface. A monitoring plan must be submitted to the Agency for approval which indicates the location, sample frequency, and the duration of the monitoring program. Should the instream monitoring data indicate that less stringent ammonia nitrogen effluent limitations are protective of the receiving stream, this Permit may be modified to include alternate ammonia nitrogen effluent limitations designed to prevent exceedances of the ammonia nitrogen water quality standards.

`Attachment H

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.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-2829
BRUCE RAUNER, GOVERNOR LISA BONNETT, DIRECTOR

217/782-0610

September 23, 2015

RECEIVED
SEP 25 2015
BY:

Glenbard Wastewater Authority
21 W 551 Bemis Road
Glen Ellyn, Illinois 60137

Re: Glenbard Wastewater Authority
GWA CSO Stormwater Facility
NPDES Permit No. IL0022471
Final Permit

Gentlemen:

Attached is the final NPDES Permit for your discharge. The Permit as issued covers discharge limitations, monitoring, and reporting requirements. Failure to meet any portion of the Permit could result in civil and/or criminal penalties. The Illinois Environmental Protection Agency is ready and willing to assist you in interpreting any of the conditions of the Permit as they relate specifically to your discharge.

The Agency has completed our review of the comment letter dated August 10, 2015 submitted by Baxter & Woodman, on your behalf and the comment letter dated September 1, 2015, and offers the following response:

1. The time frame to submit the public notice information meeting summary in Special Condition 12, Paragraph G.12 has been increased to 90 days.

2. Glenbard Wastewater Authority was not required to develop or implement a Long Term Control Plan based on the facility already complying with the presumptive approach of the Combined Sewer Overflow (CSO) Policy. Therefore, this is not a Phase II Permit and USEPA has determined that the language included in Special Condition 12.G.11.B was for informational purposes only and removed from the final permit. The language was included in the public notice/fact sheet.

3. The language revisions in Special Condition 12.B.3 are consistent with the CSO Policy. All discharges are required to not cause or contribute to violations of water quality standards.

4. A portion of the collection system is a separate sewer system. Therefore, the Capacity, Management, Operations, and Maintenance (CMOM) plan requirements remain in the final permit. Glenbard Wastewater Authority is only required to develop a plan for the separate sewer collection system owned and operated by the Authority.

The Agency has begun a program allowing the submittal of electronic Discharge Monitoring Reports (NetDMRs) instead of paper Discharge Monitoring Reports (DMRs). If you are interested in NetDMRs, more information can be found on the Agency website, http://epa.state.il.us/water/net-dmr/index.html. If your facility is not registered in the NetDMR program, a supply of preprinted paper DMR Forms for your facility will be sent to you prior to the initiation of DMR reporting under the reissued permit. Additional information and instructions will accompany the preprinted DMRs upon their arrival.

The attached Permit is effective as of the date indicated on the first page of the Permit. Until the effective date of any re-issued Permit, the limitations and conditions of the previously-issued Permit remain in full effect. You have the right to appeal any condition of the Permit to the Illinois Pollution Control Board within a 35 day period following the issuance date.

Should you have questions concerning the Permit, please contact Kaushal Desai at 217/782-0610.

Sincerely,

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:KKD:12020201.bah

Attachment: Final Permit

cc: Records
Compliance Assurance Section
Des Plaines Region
Billing
CMAP
DuPage River Salt Creek Workgroup
USEPA

NPDES Permit No. IL0022471

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

Reissued (NPDES) Permit

Expiration Date: August 31, 2020

Issue Date: September 23, 2015
Effective Date: September 23, 2015

Name and Address of Permittee:

Glenbard Wastewater Authority
21 W 551 Bemis Road
Glen Ellyn, Illinois 60137

Facility Name and Address:

GWA CSO Stormwater Facility
Illinois Route 53 and Hill Avenue
Lombard, Illinois 60148
(DuPage County)

Receiving Waters: East Branch of DuPage River

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 standard conditions and attachments 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.

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:KKD:12020201.bah

NPDES Permit No. IL0022471

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 Combined Sewage Treatment Facility Outfall

From the effective 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	Sample Frequency	Sample Type
Total Flow (MG)		Daily When Discharging	Continuous
BOD_5	Report	Daily When Discharging	Grab
Suspended Solids	Report	Daily When Discharging	Grab
Fecal Coliform	Daily Maximum Shall not Exceed 400 per 100 mL	Daily When Discharging	Grab
pH	Shall be in the range of 6 to 9 Standard Units	Daily When Discharging	Grab
Chlorine Residual	0.75	Daily When Discharging	Grab
Total Phosphorus (as P)	Report	Daily When Discharging	Grab

Total flow in million gallons shall be reported on the Discharge Monitoring Report (DMR) in the quantity maximum column.

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 daily maximum.

pH shall be reported on the DMR as a minimum and a maximum.

Chlorine Residual shall be reported on the DMR as monthly average.

Total Phosphorus shall be reported on the DMR as a maximum value.

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 the treatment facility shall be by or under the supervision of a Certified Class 3 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 and 303.

SPECIAL CONDITION 6. The Permittee shall record monitoring results on Discharge Monitoring Report (DMR) 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 may choose to submit electronic DMRs (NetDMRs) instead of mailing paper DMRs to the IEPA. More information, including registration information for the NetDMR program, can be obtained on the IEPA website, http://www.epa.state.il.us/water/net-dmr/index.html.

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 not using NetDMRs 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 7. The provisions of 40 CFR Section 122.41(m) & (n) are incorporated herein by reference.

SPECIAL CONDITION 8. 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 9. 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 on forms provided by IEPA titled "Fiscal Report Form For NPDES Permittees".

SPECIAL CONDITION 10. 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.

Special Conditions

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 regulations governing sewage sludge use or disposal and shall comply with all existing applicable regulations in any jurisdiction in which sewage sludge is actually used or disposed.

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" to the following address:

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

SPECIAL CONDITION 11. This Permit may be modified to include alternative or additional final effluent limitations pursuant to an approved Total Maximum Daily Load (TMDL) Study or upon completion of an DuPage River Water Quality Study.

SPECIAL CONDITION 12.

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 overflows 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
002	Old Lagoon Outfall	East Branch of DuPage River
003	90-inch CSO Bypass	East Branch of DuPage River

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.

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. Reports shall be in the form specified by the IEPA and on forms provided by the IEPA (e.g., Form IL 532-2471, or updated form of same). These forms shall be submitted to the IEPA monthly with the DMRs and covering the same reporting period as the DMRs. Parameters (other than flow frequency and volume), if required in this Permit, shall be sampled and reported as indicated in the transmittal letter for such report forms.

Special Conditions

2. All Submittals listed in this Special Condition can be mailed to the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Attention: CSO Coordinator, Compliance Assurance Section

All submittals hand carried shall be delivered to 1021 North Grand Avenue East.

B. CSO Treatment Requirements

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

a. All dry weather flows, the first flush of storm flows, and additional flows, but not less than ten times the average dry weather flow for the design year, shall be conveyed to the Glenbard Wastewater Authority Main STP for treatment.

b. Treatment necessary to comply with all applicable water quality based requirements of this permit including, but not limited to, the requirement that discharges from CSOs not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters.

4. 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.

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

6. The collection system shall be operated to optimize transport of wastewater flows and to minimize CSO discharges and the treatment system, if applicable, shall be operated to maximize treatment of wastewater flows.

C. CSO Nine Minimum Controls

7. 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.

A pollution prevention plan (PPP) shall be developed by the Permittee unless one has already been prepared for this collection system. Any previously-prepared PPP 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

Special Conditions

Permit and that the public information meeting was held. Such documentation shall be submitted to the IEPA 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 two (2) copies of the "CSO Pollution Prevention Plan Certification" one (1) with original signatures. This certification form is available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-pol-prev.pdf. 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 to the IEPA one (1) month from the revision date.

D. Sensitive Area Considerations

8. 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 include 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.

The IEPA has tentatively determined that none of the outfalls listed in this Special Condition discharge to sensitive areas. However, if information becomes available that causes the IEPA to reverse this determination, the IEPA will notify the Permittee in writing. Upon the date contained in the notification letter, the Permittee shall develop a Long Term Control Plan and schedule to eliminate or relocate these outfalls. If elimination or relocation is not economically feasible or technically achievable the Permittee shall submit a revised plan and schedule for treating the discharge. Such justification shall be in accordance with Section II.C.3 of the National CSO Control Policy.

E. CSO Operational and Maintenance Plans

9. 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 system, 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 reviewed and accepted a CSO operational and maintenance plan "CSO O&M plan" on June 26, 2000 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 to the IEPA 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 two (2) copies of the "CSO Operational Plan Checklist and Certification", one (1) with original signatures. Copies of the "CSO Operational Plan Checklist and Certification" are available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-checklist.pdf. 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 revisions shall be submitted to the IEPA one (1) month from the revision date.

F. Sewer Use Ordinances

10. The Permittee, within six (6) months of the effective date of this Permit, shall review and where necessary, modify its existing sewer use ordinance to ensure it contains provisions addressing the conditions below. If no ordinance exists, such ordinance shall be developed, adopted, and implemented within six (6) months from the effective date of this Permit. Upon completion of the review of the sewer use ordinance(s), the Permittee shall submit two (2) copies of a completed "Certification of Sewer Use Ordinance Review", one (1) copy with original signatures. Copies of the certification form can be obtained on line at http://www.epa.state.il.us/water/permits/waste-water/forms/sewer-use.pdf. The Permittee shall submit additional copies of the sewer use ordinance(s) to the IEPA upon written request. Sewer use ordinances must contain specific provisions to:

a. Prohibit introduction of new inflow sources to the sanitary sewer system;

b. Require that new sanitary sewer construction tributary to the combined sewer system be designed to minimize and/or delay inflow contribution to the combined sewer system;

c. Require that inflow sources on the combined sewer system be connected to a storm sewer, in accordance with any approved Long Term Control Plan;

d. Provide that any new building domestic sewage connection shall be distinct from the building inflow connection;

e. Assure that CSO impacts from industrial and/or commercial sources are minimized and control by determining which industrial and/or commercial discharges, are tributary to CSOs; and,

f. Assure that the owners of all publicly owned systems with sewers tributary to the Permittee's collection system have procedures in place adequate to ensure that the objectives, mechanisms, and specific procedures given in Paragraph 9 of this Special Condition are achieved.

The Permittee shall enforce the applicable sewer use ordinances.

G. Long-Term Control Planning and Compliance with Water Quality Standards

11. A. Pursuant to Section 301 of the federal Clean Water Act, 33 U.S.C. § 1311 and 40 CFR § 122.4, discharges from the CSOs, including the outfalls listed in this Special Condition and any other outfall listed as a "Treated Combined Sewage Outfall", shall not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters. In addition, discharges from CSOs shall comply with all applicable parts of 35 Ill. Adm. Code 306.305(a), (b), (c), and (d).

B. Should the results of any water quality monitoring plan or any other information indicate 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 11.A above, the Permittee shall develop and submit to IEPA three copies of 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 11.A above.

C. 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 standard or are causing use impairment in the receiving waters, then the Permittee shall develop and submit to IEPA three (3) copies of a LTCP within twelve (12) months of receiving the IEPA written notice. The 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 11.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. Implementation of the revised LTCP shall be as indicated by IEPA in writing or other enforceable mechanism.

12. 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. Signage'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 within 90 days of holding the public meeting. The Permittee shall submit copies of the public notification program to the IEPA upon written request.

13. 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.

H. Summary of Compliance Dates in this CSO Special Condition

14. The following summarizes the dates that submittals contained in this Special Condition are due at the IEPA (unless otherwise indicated):

Submission of CSO Monitoring Data (Paragraph 1)	25th of every month
Submission of Revised CSO O & M Plan (Paragraph 9)	1 month from the revision date
Elimination of a CSO or Discovery of Additional CSO locations (Paragraph 13)	1 month from discovery or elimination
Control (or Justification for No Control) of CSOs to Sensitive Areas (Paragraph 8)	Upon date contained in IEPA notification letter
Conduct Pollution Prevention and PN Public Information Meeting (Paragraphs 7 and 12). **No Submittal Due with this Milestone**	Annually
Certification of Sewer Use Ordinance Review (Paragraph 10)	6 months from the effective date of this Permit
Conduct OMP Public Information Meeting (Paragraph 9) **No Submittal Due with this Milestone**	9 months from the effective date of this Permit
Submit Pollution Prevention Certification and OMP Certification (Paragraphs 7 and 9)	12 months from the effective date of this Permit
Submit PN Information Meeting Summary (Paragraph 12)	90 days after public meeting

All submittals listed in this paragraph shall be mailed to the following address:

Illinois Environmental Protection Agency
Bureau of Water, Compliance Assurance Section
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Attention: CSO Coordinator, Compliance Assurance Section

All submittals hand carried shall be delivered to 1021 North Grand Avenue East.

Reopening and Modifying this Permit

15. 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 13. 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 Ill. Adm. Code 306.304. In order to accomplish these goals of complying with this prohibition 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 occur, and (B) develop, implement and submit to the IEPA a Capacity, Management, Operations, and Maintenance (CMOM) plan which includes an Asset Management strategy within twenty four (24) months of the effective date of this Permit or review and revise any existing plan accordingly. 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 were 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 back-ups occur or are likely to occur; use flow monitoring as necessary;
5. Identification and prioritization of structural deficiencies in the system owned and operated by the Permittee;
6. Operational control, including documented system control procedures, scheduled inspections and testing;
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.

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. Special provisions for Pump Stations and force mains and other unique system components; and
4. 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_bestpractices.pdf

`Attachment H

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.

APPENDIX C
SAMPLE JAR TESTING PROTOCOL

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Memorandum

Date: December 2018

To: Glenbard Wastewater Authority

From: Trotter & Associates, Inc.

Subject: Chemical Phosphorus Removal – Sample Jar Testing Protocol

Objective

In order to evaluate the potential for chemical phosphorus removal, laboratory jar testing is recommended. The results from the jar testing will be analyzed by TAI in order to

- Confirm the amount of chemical necessary in order to optimize phosphorus removal
- Confirm the solids production resulting from the use of metal salts for precipitation of phosphorus
- Determine the soluble non-reactive fraction of phosphorus in the plant's process flow

It is anticipated that a total of 10 jar tests will be necessary in order to produce the information needed for the evaluation of chemical phosphorus removal through the use of a metal salt as a coagulant. The jar testing can be performed in-house if the equipment is available, by an outside laboratory, or a combination of both.

It is important to note that this jar testing protocol has not been designed to evaluate mixing kinetics as they relate to phosphorus removal at the facility. It is recommended that mixing is evaluated during the detail design phase of the phosphorus removal implementation as in poorly mixed systems phosphorus removal can be decreased as much as 25-percent compared to well-mixed systems. Clearly, this factor has an impact on both chemical costs, and sludge production and handling.

Metal Salts

There are several metals salts that have been proven to be effective for phosphorus removal in domestic wastewater. It is important to note that the selection of which metal salt will best suit the need of the user is project specific with great importance given to the operation cost of the selected salt but there are also other importance non-economic considerations including:

- Metal salt handling hazards
- Commonality with other plant or Utility processes
- Storage requirements (especially in cold climates)
- Metal salts shelf life (important if seasonal TP limits are in effect)
- Impact to plant's processes, including sludge generation

The selection of the metal salt to be used at the GAWTF will be discussed in the report. However, the most commonly used metals salts for TP removal are ferric chloride and aluminum sulfate, as they have proven to be the most cost beneficial alternatives for most plants as a starting point. For the purposes of jar testing, ferric chloride is recommended.

The metal salts will be used to create chemical precipitation which targets soluble orthophosphate removal. The removal occurs through coagulation from solution into a solid, and that solid is removed via clarification or filtration. This solid can be removed in primary clarifiers with primary solids; it can be removed in final clarifiers as part of the mixed liquor (with the associated improved sludge settling properties); it can be removed in tertiary filters; or it can be removed in any combination of the three, with removal efficiencies generally increasing with the number of chemical addition points. Despite the widespread acceptance and use of this approach, the solid conversion mechanisms of orthophosphate have not been well understood and the success of chemical precipitation of phosphorus is highly dependent upon site specific conditions.

As a result it is important to conduct jar testing to determine the optimal chemical and dose of metal salt to be used for this process. The following section outlines the sample location, chemical preparation, specific jar testing procedures, and analytical requirements that will be used at each facility.

Jar Test Protocol

Sample Locations

Jar tests will be conducted for wastewater samples collected at various locations at the facility, selected because they are potential chemical feed points for phosphorus removal. Based on typical dosing locations, potential locations for the Authority's chemical feed are the primary clarifiers, the mixed liquor upstream of the splitter box feeding the final clarifiers, and final clarifier effluent (disc filter influent). The MLSS feed point allows for chemical sludge to be formed and mostly removed in the clarifiers. Because the RAS flow recycles most of the final clarifier solids to the intermediate pump station which carries it to the HPO basins, chemical addition at the final clarifiers will also result in chemical solids in the two-stage HPO basins. For improved removal efficiency, chemical feed to the clarifier effluent should also be considered. The solids formed in the final clarifiers would be removed in a subsequent solids separation step. The jar testing allows for evaluation of the optimized chemical dose to achieve maximum removal in a single step.

Side stream recycle within a GAWTF is also a potential chemical addition point because of the high phosphorus concentrations often found in these waste streams. In the case of the Authority, the belt filter press filtrate is a potential source of phosphorus where chemical could be added.

Samples will need to be pulled from:

- Influent
- MLSS
- Secondary Effluent
- Filtrate

Preparation of Metal Salt Stock Solutions

Stock metal salt solutions will be prepared from the metal salt samples obtained from either the Authority or from chemical vendors no more than 24 hours prior to jar testing. The material safety data sheet will be used to determine the percent solution (by weight) and bulk solution density. This information will be used to prepare 4,000 mg/L (as metal salt) stock solution. The 4,000 mg/L stock solution allows the two liter beakers for the jar test to be dosed with concentrations as high as 400 mg/L with no more than a 10 percent change in test volume. Additionally, this stock concentration allows doses to be determined in the field with no field calculations which can significantly reduce errors in dosing; thus, for a 50 mg/L dose, a stock volume of 25 mL would be added to the 2L jar and for 100 mg/L, a stock volume of 50 mL would be added to the 2L jar, and so forth.

The appropriate volume of vendor/Authority supplied stock solution will be transferred into a two liter volumetric flask using volumetric, graduated pipets. The flask will then be filled to volume with purified, deionized water and mixed. The 4000 mg/L stock solutions will be transferred to clean glass or plastic storage bottles with a tight fitting lid.

Jar Test Procedures

The sample must be collected immediately before each jar test is run. A screening level jar test will be conducted to target more focused coagulant dose ranges, prior to running the jars from which analytical samples will be collected. The screening level testing allows field personnel to use surrogate field parameters to target a series of concentrations that will provide more accurate information on chemical dose optimization. Surrogate field parameters will include turbidity, ultraviolet transmittance (UVT) and field orthophosphate (ortho-P) as indicators of the effectiveness of the coagulation/flocculation reactions for each chemical and dose. A matrix of the doses to be used for screening tests is shown in Table 1.

Table 1: Screening Jar Test Matrix

Parameter	Control	Jar 1	Jar 2	Jar 3	Jar 4	Jar 5
Ferric Chloride (mg/L as $FeCl_3$)	0	10	30	60	100	150

Once the screening jar tests have been completed, field personnel should immediately run the jar testing for analytical testing. The chemical dose for each of these tests will be determined in the field based on the results of the screening jar test. Using the UVT, turbidity and field ortho-P results to determine the best performance of the wide range of metal salt doses, field personnel will select a dose range that brackets the best jars.

All experiments will be performed in a six paddle, Phipps-Bird jar test unit with 2L square beakers. This configuration will allow up to five concentrations of a metal salt to be tested, in addition to a control sample for each test. The procedure that will be used for each jar test follows:

Test 1 Screening Test:

1. Transfer 2 liters of sample from a collection bucket into each of the six square jar testing beakers.
2. Simultaneously dose each beaker with the appropriate volumes of prepared stock solution using either graduated cylinders or syringes, depending upon the volume required.
3. Stir the beakers at 300 rotations per minute (rpm) for 45 seconds to simulate a rapid mix or chemical induction phase.
4. Stir the beakers an additional two minutes at 60 rpm to allow coagulated materials to flocculate.
5. Turn the stirrers off and allow the samples to settle for 30 minutes.
6. Collect supernatant from each jar and pour into a small beaker so that field measurements of temperature, pH, ORP, conductivity and turbidity can be measured; also collect a sample for UVT measurement. Measure field parameters and record data in a field log book.
7. Select the dose range for the jar testing to be conducted for laboratory analysis by identifying the best two jars; those are the jars that have the lowest turbidity and highest UVT. Use this information to develop a targeted dose range for the second set of jar testing.

Test 2 Analytical Testing:

1. Transfer 2 liters of sample from a collection bucket into each of the six square jar testing beakers.
2. Simultaneously dose each beaker with the appropriate volumes of prepared stock solution using either graduated cylinders or syringes, depending upon the volume required based on volumes determined in screening test.
3. Stir the beakers at 300 rotations per minute (rpm) for 45 seconds to simulate a rapid mix or chemical induction phase.
4. Stir the beakers an additional two minutes at 60 rpm to allow coagulated materials to flocculate.
5. Turn the stirrers off and allow the samples to settle for 30 minutes.
6. Supernatant will be taken from each sample and analyzed as follows:
    a. Five raw samples each tested for
        i. Alkalinity
        ii. Hardness
        iii. Total Iron
        iv. Ortho- Phosphate
        v. Total Hydrolysable Phosphorus
        vi. Total Phosphorus
        vii. TSS
        viii. pH
        ix. UVT (<u>to be coordinated with another lab, if necessary</u>)
    b. Five filtered (dissolved) samples each tested for
        i. Total Iron
        ii. Ortho-Phosphate

iii. Total Hydrolysable Phosphorus
iv. Total Phosphorus
v. TSS

7. Collect supernatant from each jar and pour into a small beaker so that field measurements of:
   a. Temperature
   b. pH
   c. ORP
   d. Conductivity
   e. Turbidity can be measured; also collect a sample for UVT measurement. Measure field parameters and record data in a field log book.
8. In addition to the field parameters, collect settled water samples to be submitted for analytical testing
9. Once settled water samples have been collected, filter sufficient sample from the three best jars using a 0.45µm filter and collect filtrate to be submitted for analytical testing
10. Each sample will be identified by sample location, the metal salt and dose used, whether the sample is settled or filtered water and the date as follows: LOC-CHEMDOSE-FIL/SET-DATE10. For a sample of settled water from an influent sample jar test that was dosed with 50 mg/L of ferric chloride, tested on December 15 would be noted as follows: INF-FER50-SET-121518. For a sample of filtered water from an effluent sample jar test that was dosed with 100 mg/L of alum, tested on December 15 would be noted as follows: EFF-ALUM100-FIL-121518.
11. All laboratory samples should be packed in ice and delivered to the laboratory within 24 hours along with a sample Chain of Custody (COC) form. A sample jar test worksheet that may be used in the field is provided in Appendix B.

Sample	PH	Alkalinity mg/L as CaCO3	Hardness mg/L as CaCO3	Iron mg/L as CaCO3	TSS mg/L	TP mg/L	TRP mg/L	THP mg/L
Influent								
Control	1	1	1	-	1	1	1	1
Field Filtered Control	-	-	-	1	-	1	1	1
Best Jar- A	2	2	2	-	2	2	-	-
Field Filtered Jar-A	-	-	-	1	-	-	-	-
MLSS (splitter box to final clarifiers)								
Control	1	1	1	-	1	1	1	1
Field Filtered Control	-	-	-	1	-	1	1	1
Best Jar- A	2	2	2	-	2	2	2	2
Field Filtered Jar-A	-	-	-	1	-	2	2	2
Secondary Effluent								
Control	1	1	1	-	1	1	1	1
Field Filtered Control	-	-	-	1	-	1	1	1
Best Jar- A	2	2	2	-	2	2	2	2
Field Filtered Jar-A	-	-	-	1	-	2	2	2
Filtrate								
Control	1	1	1	1	1	1	-	-
Best Jar- A	2	2	2	1	2	2	-	-
Total Samples	**12**	**12**	**12**	**8**	**12**	**15**	**14**	**14**

Laboratory Parameters and Methods

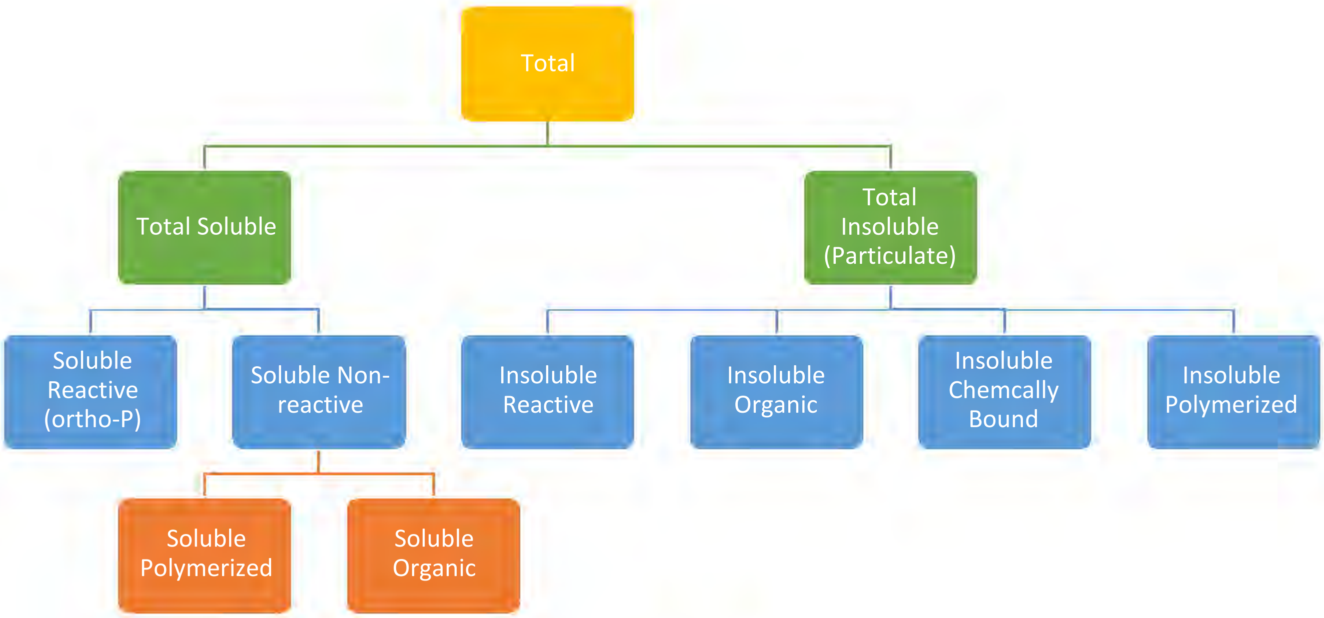
The purpose of this evaluation is to select and optimize the metal salt to be used for chemical precipitation of phosphorus. Laboratory analyses will be conducted on samples collected from the jar tests to aid in characterizing phosphorus speciation. The phosphorus parameters include total phosphorus (TP), hydrolysable phosphorus (THP), ortho-phosphorus or total reactive phosphorus (TRP) and soluble non-reactive phosphorus (SNRP). Both filtered and unfiltered samples (filtration will be conducted in the field) will be submitted to the laboratory for these analyses.

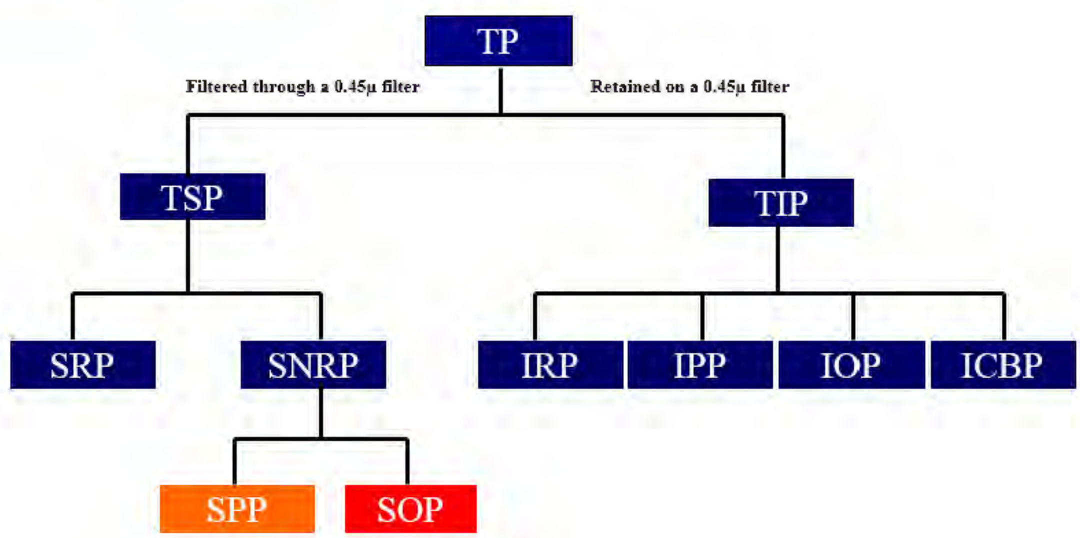
Addition of metal salts for chemical precipitation can consume alkalinity and depress the solution pH. The NPDES permit limits on pH is between 6.0 and 9.0. During wastewater treatment using activated sludge processes, substantial alkalinity can be consumed during nitrification and alkalinity could remain low if a possible denitrification process cannot produce adequate alkalinity. Therefore, both pH and alkalinity will be measured, in the laboratory.

The analytical parameters to be collected for each jar test and the total sample numbers are provided in **Table 2** below.

Table 2: Analytical Methods

Parameter	Preferred Analytical Method	Sample Volume & Container	Maximum Holding Time	Preservation Method
pH	SM 4500-H	100 mL Plastic or Glass	24 hours	Refrigerate at 4C
Alkalinity	SM 2340	100 mL Plastic or Glass	14 days	Refrigerate at 4C
Hardness	SM 2340	100 mL Plastic or Glass	14 days	Refrigerate at 4C
Iron	SM 3500	100 mL Plastic or Glass	At pH < 2, 6 months	Concentrated HNO3, Refrigerate at 4C
Total Phosphorus (TP)	SM 4500-P B.5. Persulfate Digestion, followed by SM 4500-P E. Ascorbic Acid Method	100 mL Pre-Cleaned Glass	48 hours	Refrigerate at 4C
Total Hydrolysable Phosphorus	SM4500-P B.2. Acid Hydrolysis, followed by 4500-P.E. Ascorbic Acid Method	See TP	48 hours	Refrigerate at 4C
Total Reactive Phosphorus (TRP)	SM 4500-P E. Ascorbic Acid Method	See TP	48 hours	Refrigerate at 4C
Total Suspended Solids (TSS)	SM 2540	100 mL Plastic or Glass	7 days	Refrigerate at 4C

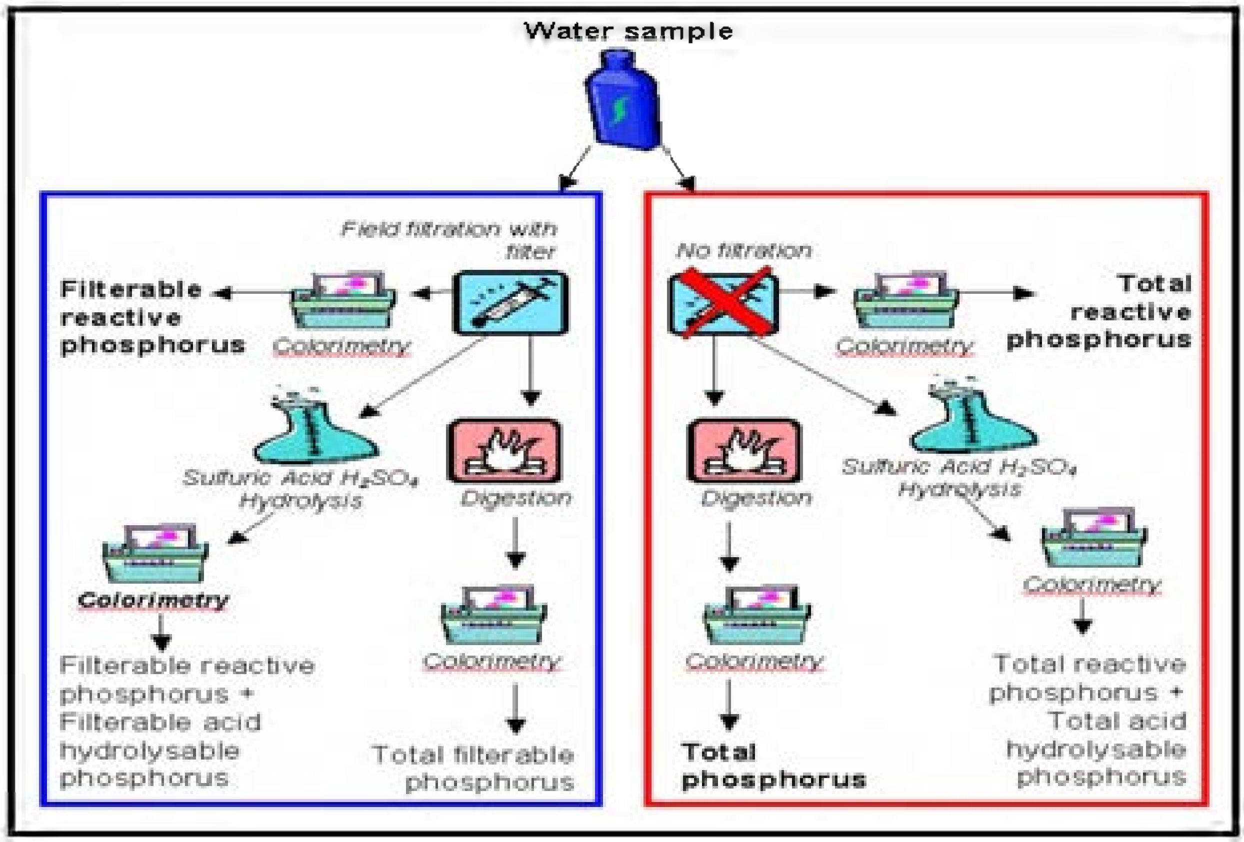




KEY:

TP = Total Phosphorus
TSP = Total Soluble (Dissolved) Phosphorus
SRP = Soluble reactive phosphorus (ortho-p)
SNRP = Soluble non-reactive phosphorus
SPP = Soluble Polymerized (acid hydrolysable) Phosphorus
SOP = Soluble Organic Phosphorus

TIP = Total Insoluble (Particulate) Phosphorus
IRP = Insoluble Reactive Phosphorus
IPP = Insoluble Polymerized (acid hydrolysable) Phosphorus
IOP = Insoluble Organic Phosphorus
ICBP = Insoluble Chemically Bound Phosphorus


Water sample
Field filtration with filter
Filterable reactive phosphorus
Colorimetry
Sulfuric Acid H_2SO_4 Hydrolysis
Digestion
Colorimetry
Colorimetry
Filterable reactive phosphorus + Filterable acid hydrolysable phosphorus
Total filterable phosphorus
No filtration
Colorimetry
Total reactive phosphorus
Digestion
Sulfuric Acid H_2SO_4 Hydrolysis
Colorimetry
Colorimetry
Total phosphorus
Total reactive phosphorus + Total acid hydrolysable phosphorus

APPENDIX D
CONDITION ASSESSMENTS

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	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Bar Screen Building						
Mechanical Bar Screen #1	Headworks	Mahr	Good	2007	25	2032
Mechanical Bar Screen #2	Headworks	Mahr	Good	2007	25	2032
Washer	Lakeside	-	Poor	2006	20	2026
Conveyor	Hycor	-	Poor	1998	20	2018
Raw Sewage Pump Station						
Raw Sewage Pump #1	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #2	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump #3	Patterson	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #1	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #2	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump Motor #3	US Motor	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #1	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #2	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Raw Sewage Pump VFD Drive #3	Culter-Hammer	-	Currently Being Replaced	2018	25	2043
Wet Well Drain Pump	Gorman Rupp	-	Currently Being Replaced	2018	25	2043
Grit Building						
Vortex Grit Washer #1	Huber	-	Good	2005	20	2025
Vortex Grit Washer #2	Huber	-	Good	2005	20	2025
Aeration Blower #1	Lamson	Turbotron	Fair	2009	20	2029
Aeration Blower #2	Lamson	Turbotron	Fair	2009	20	2029
Mag Meter - Raw Flows - 36"	ABB		Fair	2011	20	2031
Grit Pump #1	Morris	-	Good	2005	15	2020
Grit Pump #2	Morris	-	Good	2005	15	2020
Grit Removal Chamber #1	Smith & Loveless	PISTA	Fair	2005	20	2025
Grit Removal Chamber #2	Smith & Loveless	PISTA	Fair	2005	20	2025
Grit Blower Flow Meter	-	-	-	2005	20	2025
Grit Blower Flow Meter	-	-	-	2005	20	2025
Primary Clarifiers						
Primary Clarifier #1 Collector	Eimco	-	Fair	1977	30	2007
Primary Clarifier #1 Drive	Westec	-	Fair	1999	15	2014
Primary Clarifier #1 Motor	Eimco	-	Fair	1977	15	1992
Primary Clarifier #2 Collector	Eimco	-	Fair	1977	30	2007
Primary Clarifier #2 Drive	Westec	-	Fair	2004	15	2019
Primary Clarifier #2 Motor	Eimco	-	Fair	1977	15	1992

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Primary Sludge						
Primary Sludge Pump #1	Moyno	-	Fair	2007	15	2022
Primary Sludge Pump #2	Moyno	-	Fair	2007	15	2022
Primary Sludge Grinder #1	JWC	Muffin Monster	Fair	2007	15	2022
Primary Sludge Grinder #2	JWC	Muffin Monster	Fair	2007	15	2022
Scum Pump #1	Yeomans Pump	SDV Series 4000	Fair	2007	15	2022
Scum Pump #2	Yeomans Pump	SDV Series 4000	Fair	2007	15	2022
Air Compressor #1	Gardner Denver	-	Fair/Poor	2007	10	2017
Air Compressor #2	Gardner Denver	-	Fair/Poor	2007	10	2017
Primary Sludge Mag Meter - 10"	-	-	Poor	2010	20	2030
Primary Sludge Mag Meter - 10"	-	-	Poor	2010	20	2030
Cabo Mag Meter - 24"	ABB	-	Poor	2014	10	2024
Nitro Mag Meter - 24"	ABB	-	Poor	2014	10	2024
Primary Scum Concentrator/Compactor	Lakeside	-	Good	2010	20	2030
Scum Wash Water Pump	-	-	Good	2010	15	2025

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
UNOX System						
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #1	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #2	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #3	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #4	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #5	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #6	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #7	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #8	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #9	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #10	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #11	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #12	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #13	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #14	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #15	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #16	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #17	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #18	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #19	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #20	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #21	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #22	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #23	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #24	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #25	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #26	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #27	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #28	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #29	Union Carbide, Unox System	LAR 60L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #1	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #2	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #3	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #4	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #5	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #6	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #7	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #8	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #9	Union Carbide, Unox System	LAR 90L	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #1	Union Carbide, Unox System	-	Fair	1977	25	2002
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #2	Union Carbide, Unox System	-	Fair	1977	25	2002

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Pure Ox Supply Valve & Operator - 6" #1	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #2	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #3	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #4	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #5	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #6	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #7	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #8	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #9	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Valve & Operator - 6" #10	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #1	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #2	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #3	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #4	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #5	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #6	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #7	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #8	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #9	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Supply Iso Valve - 6" #10	DeZurik	-	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #1	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #2	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #3	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #4	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #5	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #6	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Waste Valve - 6" #7	DeZurik	9099862	Fair/Poor	1977	20	1997
Pure Ox Purge Blower #1	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #2	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #3	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #4	Siemens-Allis	-	Poor	1977	30	2007
Pure Ox Purge Blower #5	Siemens-Allis	-	Poor	1977	30	2007
Intermediate Clarifiers						
Intermediate Clarifier #1 Collector	Walker	-	Fair	1969	30	1999
Intermediate Clarifier #1 Drive	Westec	-	Fair	2007	15	2022
Intermediate Clarifier #1 Motor	Walker	-	Fair	1969	15	1984
Intermediate Clarifier #2 Collector	Walker	-	Fair	1977	30	2007
Intermediate Clarifier #2 Drive	Westec	-	Fair	1999	15	2014
Intermediate Clarifier #2 Motor	Walker	-	Fair	1977	15	1992
Telescoping Valves (6)	-	-	Poor	1977/2003	15	1999
Parshall Metering Flume	-	-	Good/Fair	1955	50	2005

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Carbonaceous Return Activated Sludge						
Carbo Wasting Pump #1	ABS	XFP 80C CB1	Good	2015	20	2035
Carbo Ras Return Flow Meter/Parshall Flume #1	-	-	Good/Fair	1977	50	2027
Carbo Ras Return Flow Meter/Parshall Flume #2	-	-	Good/Fair	1977	50	2027
Carbo RAS Pump #1	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #2	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #3	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Carbo RAS Pump #4	Aurora	-	Worn - Wear Rings Lashed	1997	20	2017
Intermediate Pump Station						
Intermediate Screw Pump #1	Lakeside	84" Archimedes Screw	Good	2014	30	2044
Intermediate Screw Pump #2	Lakeside	84" Archimedes Screw	Fair/Poor	1977	30	2007
Intermediate Screw Pump #3	Lakeside	84" Archimedes Screw	Fair/Poor	1977	30	2007
Pump #1 Lower Bearing	Lakeside	-	Good	2014	10	2024
Pump #2 Lower Bearing	Lakeside	-	Fair	2005	10	2015
Pump #3 Lower Bearing	Lakeside	-	Fair	2005	10	2015
Pump #1 Upper Bearing	Lakeside	-	Good	2014	10	2024
Pump #2 Upper Bearing	Lakeside	-	Good	2011	10	2021
Pump #3 Upper Bearing	Lakeside	-	Good	2011	10	2021
Final Clarifiers						
Final Clarifier #1 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #1 Drive	Westec	-	Good	1999	15	2014
Final Clarifier #1 Motor	-	-	Fair	1977	15	1992
Final Clarifier #1 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #2 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #2 Drive	Westec	-	Good	2001	15	2016
Final Clarifier #2 Motor	-	-	Fair	1977	15	1992
Final Clarifier #2 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #3 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #3 Drive	Westec	-	Good	2002	15	2017
Final Clarifier #3 Motor	-	-	Fair	1977	15	1992
Final Clarifier #3 Launder Covers	Nefco	-	Good	2017	20	2037
Final Clarifier #4 Collector	Envirotech Eimco	-	Fair	1977	30	2007
Final Clarifier #4 Drive	Westec	-	Good	2002	15	2017
Final Clarifier #4 Motor	-	-	Fair	1977	15	1992
Final Clarifier #4 Launder Covers	Nefco	-	Good	2017	20	2037

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Sludge Pump Station						
Nitro WAS Pump #1	Shanley Pump	SED 560 1 H311P11	Fair	2004	20	2024
Nitro WAS Pump #2	Shanley Pump	SED 560 1 H311P12	Fair	2004	20	2024
Final Clarifier RAS Waste Pump VFD #1	-	-	Fair	2009	15	2024
Final Clarifier RAS Waste Pump VFD #2	-	-	Fair	2009	15	2024
Nitro Mag Meter - 4"	-	-	Replace	2003	20	2023
Carbo Mag Meter - 4"	-	-	Replace	2003	20	2023
Thickener Refresh Water Mag Meter - 3"	-	-	Replace	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #1	ABB Fischer & Porter	10DX3111EDE19P	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #2	ABB Fischer & Porter	1A2HKZ1321	Fair	2003	20	2023
Final Clarifier RAS Mag Meter - 10 " #3	ABB Fischer & Porter	10DX3111EDE19P	Fair	2010	20	2030
Final Clarifier RAS Mag Meter - 10 " #4	ABB Fischer & Porter	1A2HKZ1321	Fair	2010	20	2030
Thickened Sludge Pump	Moyno	1G175G1 CDQ 35AA	Good	2010	15	2025
Thickened Sludge Pump	Moyno	1G175G1 CDQ 35AA	Good	2010	15	2025
RAS Control Valve - 18" #1	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #2	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #3	Limitorque MX	-	Good	1977	15	1992
RAS Control Valve - 18" #4	Limitorque MX	-	Good	1977	15	1992
Thickened Sludge Mag Meter - 4" #1	ABB Fischer & Porter	-	Fair	2010	20	2030
Thickened Sludge Mag Meter - 4" #2	ABB Fischer & Porter	-	Fair	2003	20	2023
Tertiary Treatment Building						
Disc Filter No. 1	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 2	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 3	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 4	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 5	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disc Filter No. 6	Veolia/Kruger	Hydrotech	Good	2017	20	2037
Disinfection Building						
UV Disinfection Unit #1	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #2	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #3	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #4	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #5	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #6	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #7	Fischer & Porter	-	Good	2017	20	2037
UV Disinfection Unit #8	Fischer & Porter	-	Good	2017	20	2037
Non-Pot Pump #1	Grundfos	-	Good	2010	20	2030
Non-Pot Pump #2	Grundfos	-	Good	2010	20	2030
Non-Pot Pump #3	Grundfos	-	Good	2010	20	2030
Final Effluent Flow Meter	-	-	Fair	2006	20	2026

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Gravity Sludge Thickener						
Gravity Sludge Thickener Cover	-	-	Fair	1977	30	2007
Gravity Sludge Thickener Collector	-	-	Fair	1977	30	2007
Gravity Sludge Thickener Drive	Westec	-	Fair	1999	15	2014
Gravity Sludge Thickener Motor	-	-	Fair	1977	15	1992
Anaerobic Digesters						
Anaerobic Digester Cover #1	Walker Process	-	Good	2010	25	2035
Anaerobic Digester Cover #2	Walker Process	-	Good	2010	25	2035
Anaerobic Digester Cover #3	Walker Process	-	Good	2010	25	2035
Waste Gas Burner	Varec Biogas	-	Good	2010	25	2035
Anaerobic Digester Boiler #1	US Filter	-	Good	2010	25	2035
Anaerobic Digester Boiler #2	US Filter	-	Good	2010	25	2035
Anaerobic Digester Mixing Pump #1	Vaughan	V00641	Good	2010	20	2030
Anaerobic Digester Mixing Pump #2	Vaughan	V00580	Good	2010	20	2030
Anaerobic Digester Mixing Pump #3	Vaughan	V00641	Good	2010	20	2030
Anaerobic Digester Mixing Pump #4	Vaughan	V00580	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #1	Moyno	-	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #2	Moyno	-	Good	2010	20	2030
Anaerobic Digester Sludge Circulation Pump #3	Moyno	-	Good	2010	20	2030
Sludge Grinder #1	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #2	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #3	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #4	JWC	Muffin Monster	Good	2010	20	2030
Sludge Grinder #5	JWC	Muffin Monster	Good	2010	20	2030
Belt Filter Press Feed Pump #1	Moyno	-	Good	2010	20	2030
Belt Filter Press Feed Pump #2	Moyno	-	Good	2010	20	2030
Digester Transfer Pump #1	Wemco-Hidrostal	E4K-S-E25M	Good	2010	20	2030
Digester Transfer Pump #2	Wemco-Hidrostal	E4K-S-E25M	Good	2010	20	2030
Sludge Thickening/Dewatering						
Gravity Belt Thickener	Ashbrook	Aquabelt	Not in Use	2003	20	2023
Polymer Mixing Unit #1	Norchem Industries	ACDU120/530W3H	Good	2018	15	2033
Polymer Mixing Unit #2	Norchem Industries	ACDU120/530W3H	Good	2018	15	2033
Belt Filter Press #1	Ashbrook-Simon-Hartley	Klampress	Fair	1991	20	2011
Belt Filter Press #2	Ashbrook-Simon-Hartley	Klampress	Fair	1991	20	2011
Polymer Transfer Pump #1	Moyno Pumps	-	Good	2003	15	2018
Polymer Transfer Pump #2	Moyno Pumps	-	Good	2003	15	2018
Polymer Transfer Pump #3	Moyno Pumps	-	Good	2003	15	2018
Polymer Day Tanks #1	Snyder Ind.	ASM TK 500VOT x48TDHD/NAT	Good	2003	30	2033
Polymer Day Tanks #2	Snyder Ind.	ASM TK 500VOT x48TDHD/NAT	Good	2003	30	2033

	Manufacturer	Model	Condition	Installation Year	Service Life	Replacement Year
Generator Building						
Switchgear Battery Array	-	-	Good	1995	35	2030
Generator #1	Caterpillar	-	Good	1995	35	2030
Generator #2	Caterpillar	-	Good	1995	35	2030
Generator #3	Caterpillar	-	Good	1995	35	2030
Natural Gas Generator #1	Caterpillar	G3516	Good	1995	35	2030
Natural Gas Generator #2	Caterpillar	G3516	Good	1995	35	2030
Natural Gas Generator #3	Caterpillar	G3516	Good	1995	35	2030
Radiator Drive Motor #1	-	-	Good	1995	35	2030
Radiator Drive Motor #2	-	-	Good	1995	35	2030
Radiator Drive Motor #3	-	-	Good	1995	35	2030
Radiator Drive Motor #4	-	-	Good	1995	35	2030
Radiator Drive Motor #5	-	-	Good	1995	35	2030
Radiator Drive Motor #6	-	-	Good	1995	35	2030
Aftercooler #1	-	-	Good	1995	35	2030
Aftercooler #2	-	-	Good	1995	35	2030
Aftercooler #3	-	-	Good	1995	35	2030
Co-Gen System Boost Transformer	S&C	-	Good	1995	35	2030
Cryo Plant - Not In Service						
Nitrification Basins - Not In Service						
Backwash Holding Tank - Not In Service						

APPENDIX E
CIP COST ESTIMATES

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E. Capital Improvement Project Cost Estimates

Primary Clarifier Rehabilitation

Primary Clarifier Rehabilitation				
Description				Total Probable Cost
		SUMMARY		
GENERAL CONDITIONS				$269,180
SITE WORK				$30,500
PRIMARY CLARIFIERS				$638,000
PRIMARY SLUDGE PUMPING				$608,000
Construction Sub-Total				$1,545,680
Contingency @ 15%				$231,852
Engineering @ 15%				$266,630
			PROBABLE PROJECT COST:	**$2,044,162**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$10,000	$10,000
Supervision	6	Mo.	$16,000	$96,000
Surveying	1	Lump Sum	$5,000	$5,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$25,530	$25,530
Overhead and Profit (10%)	1	Lump Sum	$127,650	$127,650
			TOTAL GENERAL CONDITIONS:	**$269,180**
SITE WORK				
Paving Removal & Replacement (Full Depth)	100	Sq. Yd.	$150	$15,000
Sidewalk	200	Sq. Ft.	$15	$3,000
Silt Fence & SE/SC Control	1	Lump Sum	$5,000	$5,000
Restoration	1	Lump Sum	$7,500	$7,500
			TOTAL SITE WORK:	**$30,500**
PRIMARY CLARIFIERS				
Demo Existing Mechanisms	1	Each	$75,000	$75,000
Process				
Mechanisms (110-ft)	2	Each	$175,000	$350,000
Mechanism Installation	2	Each	$17,500	$35,000
Walkways	2	Each	$30,000	$60,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$40,000	$40,000
MCC Sections	2	Each	$20,000	$40,000
Exterior Lighting	4	Each	$2,000	$8,000
Controls / SCADA Integration	1	Lump Sum	$30,000	$30,000
			TOTAL PRIMARY CLARIFIERS:	**$638,000**

PRIMARY CLARIFIER REHABILITATION (CONT.)

PRIMARY SLUDGE PUMPING				
Demo Existing Equipment	1	Each	$50,000	$50,000
Process				
Primary Sludge Pump	2	Each	$30,000	$60,000
Primary Sludge Grinder	2	Each	$40,000	$80,000
Primary Sludge Pump/Grinder Install	2	Each	$20,000	$40,000
Scum Pump	2	Each	$10,000	$20,000
Air Compressor	2	Each	$10,000	$20,000
Primary Sludge Mag Meter - 10"	2	Each	$15,000	$30,000
Mag Meter - 24"	2	Each	$22,500	$45,000
Ductile Iron Piping - 24"	100	Lin. Ft.	$480	$48,000
Ductile Iron Piping Fittings	10	Each	$2,500	$25,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$40,000	$40,000
Electrical Connections	12	Each	$2,500	$30,000
MCC Sections	4	Each	$20,000	$80,000
Controls / SCADA Integration	1	Lump Sum	$40,000	$40,000
	TOTAL PRIMARY SLUDGE PUMPING			**$608,000**

Grit Building/Primary Clarifier Odor Control (Phase 1)

Grit Building/Primary Clarifier Odor Control (Phase 1)		
Description		Total Probable Cost
SUMMARY		
GENERAL CONDITIONS		$53,828
SITEWORK		$7,250
PRIMARY CLARIFIER COVERS		$273,000
	Construction Sub-Total	**$334,078**
	Contingency @ 15%	$50,112
	Engineering & Administration @ 15%	$57,628
	PROBABLE PROJECT COST:	**$441,817**

Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000
Supervision	1	Mo.	$16,000	$16,000
Record Drawing	1	Lump Sum	$2,000	$2,000
Bonds & Insurance (1%)	1	Lump Sum	$2,803	$2,803
Overhead and Profit (10%)	1	Lump Sum	$28,025	$28,025
		TOTAL GENERAL CONDITIONS:		**$53,828**
SITEWORK				
Sidewalk and Aprons	100	Sq. Ft	$15	$1,500
Seeding	1	Acre	$5,000	$5,000
Silt Fence	150	Lin. Ft.	$5	$750
			TOTAL SITEWORK:	**$7,250**
PRIMARY CLARIFIER COVERS				
Aluminum Cover (Launder)	3000	Sq. Ft	$65	$195,000
Cover Installation	1	Lump Sum	$78,000	$78,000
		TOTAL PRIMARY CLARIFIER COVERS		**$273,000**

GRIT BUILDING/PRIMARY CLARIFIER ODOR CONTROL (PHASE 2)

Sludge Thickening Odor Control - Alternative #2 Phase 1C (WAS Holding and GBT)	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$157,080
SITEWORK	$66,600
FINAL CLARIFIERS WAS	$197,760
SLUDGE THICKENING MODIFICATIONS	$175,000
WAS STORAGE TANK MODIFICATIONS	$325,000
Construction Sub-Total	**$921,440**
Contingency @ 15%	$138,216
Engineering & Administration @ 15%	$158,948
PROBABLE PROJECT COST:	**$1,218,604**

Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Job Trailer	3	Mo.	$1,000	$3,000
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	3	Mo.	$16,000	$48,000
Record Drawing	1	Lump Sum	$2,000	$2,000
Bonds & Insurance (1%)	1	Lump Sum	$7,644	$7,644
Overhead and Profit (10%)	1	Lump Sum	$76,436	$76,436
		TOTAL GENERAL CONDITIONS:		**$157,080**
SITEWORK				
Sidewalk and Aprons	200	Sq. Ft	$15	$3,000
Seeding	1	Acre	$5,000	$5,000
Silt Fence	600	Lin. Ft.	$5	$3,000
Paving (Full Depth)	1112	Sq Yd	$25	$27,800
Stone Subgrade	1112	Sq Yd	$20	$22,240
Geotextile Fabic	1112	Sq Yd	$5	$5,560
			TOTAL SITEWORK:	**$66,600**
FINAL CLARIFIERS WAS				
Sludge Pumps	2	Each	$35,000	$70,000
Sludge Pump Installation	2	Each	$7,500	$15,000
Granular Base	104	Cu.Yd.	$65	$6,760
6-Inch WAS DIP	350	Lin. Ft.	$160	$56,000
6-Inch Valves	6	Each	$2,500	$15,000
Mag Meter	1	Each	$10,000	$10,000
Conduit & Wire	1	Lump Sum	$10,000	$10,000
SCADA	1	Lump Sum	$15,000	$15,000
		TOTAL FINAL CLARIFIERS		**$197,760**

GRIT BUILDING/PRIMARY CLARIFIER ODOR CONTROL (PHASE 2) (CONT.)

SLUDGE THICKENING MODIFICATIONS				
Gravity Belt Thickener (GBT) Inspection	1	Each	$50,000	$50,000
Thickened Sludge Pumps	1	Each	$35,000	$35,000
Polymer Blending Unit	1	Each	$50,000	$50,000
Mag Meter	1	Each	$10,000	$10,000
Conduit & Wire	1	Lump Sum	$15,000	$15,000
SCADA	1	Lump Sum	$15,000	$15,000
		TOTAL SLUDGE THICKENING		**$175,000**
WAS STORAGE TANK MODIFICATIONS				
Demo Existing Equipment	1	Lump Sum	$50,000	$50,000
Aeration Blowers	2	Each	$35,000	$70,000
Aeration System	2	Lump Sum	$75,000	$150,000
Conduit & Wire	1	Lump Sum	$20,000	$20,000
SCADA	1	Lump Sum	$15,000	$15,000
MCC Sections	1	Each	$20,000	$20,000
		TOTAL SLUDGE THICKENING		**$325,000**

SLUDGE THICKENING ODOR CONTROL (PHASE 1)

Sludge Thickening Odor Control - Alternative #2 Phase 1				
Description				Total Probable Cost
SUMMARY				
GENERAL CONDITIONS				$41,437
SITEWORK				$22,150
PRIMARY SLUDGE				$139,685
GRAVITY THICKENER				$59,500
			Construction Sub-Total	**$262,772**
			Contingency @ 15%	$39,416
			Engineering & Administration @ 15%	$45,328
			PROBABLE PROJECT COST:	**$347,515**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Job Trailer	1	Mo.	$1,000	$1,000
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	1	Mo.	$16,000	$16,000
Record Drawing	1	Lump Sum	$2,000	$2,000
Bonds & Insurance (1%)	1	Lump Sum	$222	$222
Overhead and Profit (10%)	1	Lump Sum	$2,215	$2,215
			TOTAL GENERAL CONDITIONS:	**$41,437**
SITEWORK				
Sidewalk and Aprons	200	Sq. Ft	$15	$3,000
Seeding	1	Acre	$5,000	$5,000
Silt Fence	600	Lin. Ft.	$5	$3,000
Paving (Full Depth)	223	Sq Yd	$25	$5,575
Stone Subgrade	223	Sq Yd	$20	$4,460
Geotextile Fabic	223	Sq Yd	$5	$1,115
			TOTAL SITEWORK:	**$22,150**
PRIMARY SLUDGE				
Granular Base	149	Cu.Yd.	$65	$9,685
6-Inch WAS DIP	500	Lin. Ft.	$160	$80,000
6-Inch Valves	6	Each	$2,500	$15,000
Mag Meter	1	Each	$10,000	$10,000
Conduit & Wire	1	Lump Sum	$10,000	$10,000
SCADA	1	Lump Sum	$15,000	$15,000
			TOTAL PRIMARY SLUDGE	**$139,685**
GRAVITY THICKENER				
Ecosorb Atomization	1	Lump Sum	$50,000	$50,000
PVC Piping - Water Line	150	Lin. Ft.	$30	$4,500
Conduit & Wire	1	Lump Sum	$5,000	$5,000
			TOTAL PRIMARY SLUDGE	**$59,500**

SLUDGE THICKENING ODOR CONTROL (PHASE 2)

Sludge Thickening Odor Control - Alternative #2 Phase 1C (WAS Holding and GBT)				
Description				Total Probable Cost
SUMMARY				
GENERAL CONDITIONS				$157,080
SITEWORK				$66,600
FINAL CLARIFIERS WAS				$197,760
SLUDGE THICKENING MODIFICATIONS				$175,000
WAS STORAGE TANK MODIFICATIONS				$325,000
			Construction Sub-Total	**$921,440**
			Contingency @ 15%	$138,216
			Engineering & Administration @ 15%	$158,948
			PROBABLE PROJECT COST:	**$1,218,604**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Job Trailer	3	Mo.	$1,000	$3,000
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	3	Mo.	$16,000	$48,000
Record Drawing	1	Lump Sum	$2,000	$2,000
Bonds & Insurance (1%)	1	Lump Sum	$7,644	$7,644
Overhead and Profit (10%)	1	Lump Sum	$76,436	$76,436
			TOTAL GENERAL CONDITIONS:	**$157,080**
SITEWORK				
Sidewalk and Aprons	200	Sq. Ft	$15	$3,000
Seeding	1	Acre	$5,000	$5,000
Silt Fence	600	Lin. Ft.	$5	$3,000
Paving (Full Depth)	1112	Sq Yd	$25	$27,800
Stone Subgrade	1112	Sq Yd	$20	$22,240
Geotextile Fabic	1112	Sq Yd	$5	$5,560
			TOTAL SITEWORK:	**$66,600**
FINAL CLARIFIERS WAS				
Sludge Pumps	2	Each	$35,000	$70,000
Sludge Pump Installation	2	Each	$7,500	$15,000
Granular Base	104	Cu.Yd.	$65	$6,760
6-Inch WAS DIP	350	Lin. Ft.	$160	$56,000
6-Inch Valves	6	Each	$2,500	$15,000
Mag Meter	1	Each	$10,000	$10,000
Conduit & Wire	1	Lump Sum	$10,000	$10,000
SCADA	1	Lump Sum	$15,000	$15,000
			TOTAL FINAL CLARIFIERS	**$197,760**

SLUDGE THICKENING ODOR CONTROL (PHASE 2) (CONT.)

SLUDGE THICKENING MODIFICATIONS				
Gravity Belt Thickener (GBT) Inspection	1	Each	$50,000	$50,000
Thickened Sludge Pumps	1	Each	$35,000	$35,000
Polymer Blending Unit	1	Each	$50,000	$50,000
Mag Meter	1	Each	$10,000	$10,000
Conduit & Wire	1	Lump Sum	$15,000	$15,000
SCADA	1	Lump Sum	$15,000	$15,000
		TOTAL SLUDGE THICKENING		**$175,000**
WAS STORAGE TANK MODIFICATIONS				
Demo Existing Equipment	1	Lump Sum	$50,000	$50,000
Aeration Blowers	2	Each	$35,000	$70,000
Aeration System	2	Lump Sum	$75,000	$150,000
Conduit & Wire	1	Lump Sum	$20,000	$20,000
SCADA	1	Lump Sum	$15,000	$15,000
MCC Sections	1	Each	$20,000	$20,000
		TOTAL SLUDGE THICKENING		**$325,000**

SLUDGE DEWATERING REHABILITATION

Sludge Dewatering Rehabilitation - Belt Filter Press				
Description				Total Probable Cost
SUMMARY				
GENERAL CONDITIONS				$255,900
SITE WORK				$51,500
DEWATERING BUILDING				$1,318,500
Construction Sub-Total				$1,625,900
Contingency @ 15%				$243,885
Engineering @ 15%				$280,468
			PROBABLE PROJECT COST:	**$2,150,253**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	4	Mo.	$16,000	$64,000
Surveying	1	Lump Sum	$2,500	$2,500
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$27,400	$27,400
Overhead and Profit (10%)	1	Lump Sum	$137,000	$137,000
			TOTAL GENERAL CONDITIONS:	**$255,900**
SITE WORK				
Paving Removal & Replacement (Full Depth)	75	Sq. Yd.	$150	$11,250
Sidewalk	250	Sq. Ft.	$15	$3,750
Restoration	1	Lump Sum	$10,000	$10,000
Primary Effluent Structure Tap (Centrate)	1	Lump Sum	$2,500	$2,500
Piping				
6" DIP Centrate Piping	150	Lin. Ft.	$120	$18,000
6" DIP Drain Reroute	50	Lin. Ft.	$120	$6,000
			TOTAL SITE WORK:	**$51,500**
DEWATERING BUILDING				
Demo Existing Equipment	1	Lump Sum	$75,000	$75,000
Process				
Belt Filter Press	2	Each	$360,000	$720,000
BFP Installation	2	Each	$36,000	$72,000
Screw Conveyors	1	Lump Sum	$150,000	$150,000
Conveyor Installation	1	Lump Sum	$25,000	$25,000
Aluminum Platforms	1	Lump Sum	$50,000	$50,000
Concrete				
New Containment Walls	15	CY	$1,000	$15,000
Piping				
4" DIP Digested Sludge Piping	50	Lin. Ft.	$80	$4,000
6" DIP Drain Reroute (Inc. Saw Cutting)	50	Lin. Ft.	$300	$15,000
Electrical	4	Each	$2,500	$10,000
MCC Sections	2	Each	$20,000	$40,000
Conduit, Wiring, Labor	1	Lump Sum	$50,000	$50,000
Interior Lighting	12	Each	$2,500	$30,000
Equipment Connections	5	Each	$2,500	$12,500
SCADA/Controls	1	Lump Sum	$50,000	$50,000
			TOTAL DEWATERING BUILDING:	**$1,318,500**

INTERMEDIATE PUMPING STATION REHABILITATION

Intermediate Pumping Station Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$205,772
SITE WORK	$30,500
INTERMEDIATE PUMPING STATION	$1,167,600
Construction Sub-Total	$1,403,872
Contingency @ 15%	$210,581
Engineering @ 15%	$242,168
PROBABLE PROJECT COST:	**$1,856,621**

Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	2	Mo.	$16,000	$32,000
Surveying	1	Lump Sum	$5,000	$5,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$23,962	$23,962
Overhead and Profit (10%)	1	Lump Sum	$119,810	$119,810
			TOTAL GENERAL CONDITIONS:	**$205,772**
SITE WORK				
Paving Removal & Replacement (Full Depth)	100	Sq. Yd.	$150	$15,000
Sidewalk	200	Sq. Ft.	$15	$3,000
Silt Fence & SE/SC Control	1	Lump Sum	$5,000	$5,000
Restoration	1	Lump Sum	$7,500	$7,500
			TOTAL SITE WORK:	**$30,500**
INTERMEDIATE PUMPING STATION				
Demo Existing Equipment	1	Each	$150,000	$150,000
Process				
Intermediate Screw Pump	2	Each	$200,000	$400,000
Mechanism Installation	3	Each	$20,000	$60,000
Pump Lower Bearing	3	Each	$25,000	$75,000
Pump Upper Bearing	3	Each	$35,000	$105,000
Aluminum Covers	1200	Sq. Ft	$65	$78,000
Cover Installation	1	Lump Sum	$31,200	$31,200
Concrete				
Grout	16	Sq. Ft.	$1,000	$16,000
Installation	1	Lump Sum	$14,400	$14,400
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$50,000	$50,000
MCC Sections	7	Each	$20,000	$140,000
Exterior Lighting	4	Each	$2,000	$8,000
Controls / SCADA Integration	1	Lump Sum	$40,000	$40,000
			TOTAL INTERMEDIATE PUMPING STATION:	**$1,167,600**

INTERMEDIATE CLARIFIER REHABILITATION

Intermediate Clarifier Rehabilitation	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$156,720
SITE WORK	$30,500
INTERMEDIATE CLARIFIERS	$750,500
Construction Sub-Total	$937,720
Contingency @ 15%	$140,658
Engineering @ 15%	$161,757
PROBABLE PROJECT COST:	**$1,240,135**

Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000
Supervision	3	Mo.	$16,000	$48,000
Surveying	1	Lump Sum	$5,000	$5,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$15,620	$15,620
Overhead and Profit (10%)	1	Lump Sum	$78,100	$78,100
		TOTAL GENERAL CONDITIONS:		**$156,720**
SITE WORK				
Paving Removal & Replacement (Full Depth)	100	Sq. Yd.	$150	$15,000
Sidewalk	200	Sq. Ft.	$15	$3,000
Silt Fence & SE/SC Control	1	Lump Sum	$5,000	$5,000
Restoration	1	Lump Sum	$7,500	$7,500
			TOTAL SITE WORK:	**$30,500**
INTERMEDIATE CLARIFIERS				
Demo Existing Mechanisms	1	Each	$75,000	$75,000
Process				
Mechanisms (86-ft)	2	Each	$175,000	$350,000
Mechanism Installation	2	Each	$43,750	$87,500
Walkways	2	Each	$30,000	$60,000
T-Valves	6	Each	$10,000	$60,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$40,000	$40,000
MCC Sections	2	Each	$20,000	$40,000
Exterior Lighting	4	Each	$2,000	$8,000
Controls / SCADA Integration	1	Lump Sum	$30,000	$30,000
	TOTAL	**INTERMEDIATE CLARIFIERS:**		**$750,500**

CHEMICAL PHOSPHORUS REMOVAL (1.0 MG/L)

Chemical Phosphorus Removal (1.0 mg/L)				
Description				Total Probable Cost
SUMMARY				
GENERAL CONDITIONS				$350,532
SITE WORK				$275,250
BIOLOGICAL PROCESS I&C				$110,000
CHEMICAL FEED BUILDING				$856,600
SIDESTREAM CHEMICAL SYSTEM				$104,250
Construction Sub-Total				$1,696,632
Contingency @ 15%				$254,495
Engineering @ 15%				$292,669
			PROBABLE PROJECT COST:	**$2,243,796**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Dumpsters	0	Each	$500	$0
Job Trailer	8	Mo.	$1,000	$8,000
Eng Trailer	0	Mo.	$1,000	$0
Mobilization/Demobilization	1	Lump Sum	$10,000	$10,000
Supervision	8	Mo.	$20,000	$160,000
Surveying	1	Lump Sum	$6,000	$6,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$26,922	$26,922
Overhead and Profit (10%)	1	Lump Sum	$134,610	$134,610
			TOTAL GENERAL CONDITIONS:	**$350,532**
SITE WORK				
Paving Removal & Replacement (Full Depth)	1500	Sq. Yd.	$100	$150,000
Sidewalk	500	Sq. Ft.	$15	$7,500
Silt Fence & SE/SC Control	1	Lump Sum	$30,000	$30,000
Restoration	1	Lump Sum	$25,000	$25,000
Piping				
2" Chemical Feed Pipe	200	Lin. Ft.	$60	$12,000
6" DIP NPW	200	Lin. Ft.	$130	$26,000
NPW Yard Hydrants	4	Each	$1,500	$6,000
6" DIP Fittings	25	Each	$750	$18,750
			TOTAL SITE WORK:	**$275,250**
BIOLOGICAL PROCESS I&C				
Electrical/Controls				
MCC Sections	1	Section	$20,000	$20,000
Primary Elements				
DO Sensor	5	Each	$3,000	$15,000
Phosphate Analyzer	1	Each	$25,000	$25,000
Controllers	5	Each	$2,000	$10,000
Controls/SCADA Integration	1	Lump Sum	$40,000	$40,000
			TOTAL BIOLOGICAL PROCESS:	**$110,000**

CHEMICAL PHOSPHORUS REMOVAL (1.0 MG/L) (CONT.)

CHEMICAL FEED BUILDING				
Excavation and Fill				
Excavation	1800	Cu. Yds.	$40	$72,000
Fill	1400	Cu. Yds.	$40	$56,000
Structural				
Chemical Feed Building Walls	70	Cu. Yds.	$1,000	$70,000
Chemical Feed Building Slab	100	Cu. Yds.	$1,000	$100,000
Process				
1" PVC Piping	100	Lin. Ft.	$50	$5,000
1" PVC Valves	18	Each	$250	$4,500
3" PVC Fill Line	120	Lin. Ft.	$75	$9,000
3" PVC Valves	16	Each	$300	$4,800
10" DIP Spools	4	Each	$400	$1,600
Chemical Feed Tanks	2	Each	$40,000	$80,000
Install Tanks	2	Each	$2,000	$4,000
Chemical Metering Pumps (skid-mounted)	1	Each	$42,000	$42,000
Install Pumps	3	Each	$1,000	$3,000
Architectural				
Brick and Block	3000	Sq. Ft.	$35	$105,000
Louvers	4	Sq. Ft.	$50	$200
Exterior Single Doors (fiberglass)	2	Each	$5,000	$10,000
Exterior Roll Door	1	Each	$10,000	$10,000
Epoxy Flooring	500	Sq. Ft.	$15	$7,500
Liquid Water Repellent	3000	Sq. Ft.	$2	$6,000
Steel Lintels and Sills	40	Lin. Ft.	$20	$800
Firestopping	1	L.S.	$3,000	$3,000
Roof Planks	1500	Sq. Ft.	$12	$18,000
Roof	15	SQ	$2,000	$30,000
Coping / Fascia	125	Lin. Ft.	$20	$2,500
Paint	3000	Sq. Ft.	$3	$9,000
Fire Extinguishers	2	Each	$450	$900
Mechanical				
Eye Wash Stations	1	Each	$3,500	$3,500
Water Heater	1	Each	$1,000	$1,000
MOD & Louver	1	Each	$2,000	$2,000
Ductwork	20	Lin. Ft	$120	$2,400
Air Handling Unit	1	Each	$15,000	$15,000
Floor Drains	100	Lin. Ft	$60	$6,000
1.5" Potable Water	300	Lin. Ft	$40	$12,000
1" Condensate Line	20	Lin. Ft	$40	$800
Roof Drains	40	Lin. Ft.	$40	$1,600
Electrical				
Conduit, Wiring, Labor	1	L.S.	$20,000	$20,000
MCC Sections	2	Each	$20,000	$40,000
Interior Lighting	8	Each	$2,500	$20,000
Exterior Lighting	4	Each	$2,000	$8,000
Chemical Feed Skid	1	Each	$2,000	$2,000
Air Handling Unit	1	Each	$2,000	$2,000
Instantaneous Water Heaters	1	Each	$500	$500
Controls / SCADA Integration	1	L.S.	$65,000	$65,000
		TOTAL CHEMICAL FEED BUILDING:		**$856,600**

CHEMICAL PHOSPHORUS REMOVAL (1.0 MG/L) (CONT.)

SIDESTREAM CHEMICAL SYSTEM				
Chemical Feed Tanks (2,000 gal)	2	Each	$15,000	$30,000
Chemical Metering System	1	Lump Sum	$40,000	$40,000
Chemical Feed System Installation	1	Lump Sum	$7,500	$7,500
Piping and Valves				
1" PVC Piping	100	Lin. Ft.	$50	$5,000
3" PVC Piping	50	Lin. Ft.	$75	$3,750
Eye Wash Station	1	Each	$2,000	$2,000
Instantaneous Water Heater	1	Each	$1,000	$1,000
Electrical				
Conduit, Wiring & Labor	1	Lump Sum	$7,500	$7,500
Controls/SCADA Integration	1	Lump Sum	$7,500	$7,500
			TOTAL CHEMICAL FEED:	**$104,250**

Final Clarifier Rehabilitation

Final Clarifier Rehabilitation				
Description				Total Probable Cost
SUMMARY				
GENERAL CONDITIONS				$472,136
SITE WORK				$30,500
FINAL CLARIFIERS				$2,354,630
SLUDGE PUMPING				$766,000
Construction Sub-Total				$3,623,266
Contingency @ 15%				$543,490
Engineering @ 15%				$625,013
			PROBABLE PROJECT COST:	**$4,791,769**
Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$20,000	$20,000
Supervision	4	Mo.	$16,000	$64,000
Surveying	1	Lump Sum	$5,000	$5,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$63,023	$63,023
Overhead and Profit (10%)	1	Lump Sum	$315,113	$315,113
			TOTAL GENERAL CONDITIONS:	**$472,136**
SITE WORK				
Paving Removal & Replacement (Full Depth)	100	Sq. Yd.	$150	$15,000
Sidewalk	200	Sq. Ft.	$15	$3,000
Silt Fence & SE/SC Control	1	Lump Sum	$5,000	$5,000
Restoration	1	Lump Sum	$7,500	$7,500
			TOTAL SITE WORK:	**$30,500**
FINAL CLARIFIERS				
Demo Existing Mechanisms	1	Each	$75,000	$75,000
Process				
Mechanisms (135-ft)	4	Each	$250,000	$1,000,000
Mechanism Installation	4	Each	$25,000	$100,000
Walkways	4	Each	$30,000	$120,000
Aluminum Cover (Launder)	6800	Sq. Ft	$65	$442,000
Cover Installation	1	Lump Sum	$176,800	$176,800
Concrete				
Blast & Coat Concrete	10761	Sq. Ft.	$30	$322,830
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$40,000	$40,000
MCC Sections	2	Each	$20,000	$40,000
Exterior Lighting	4	Each	$2,000	$8,000
Controls / SCADA Integration	1	Lump Sum	$30,000	$30,000
			TOTAL PRIMARY CLARIFIERS:	**$2,354,630**

SLUDGE PUMPING				
Demo Existing Equipment	1	Each	$50,000	$50,000
Process				
Nitro WAS Pumps	4	Each	$40,000	$160,000
Thickened Sludge Pump	4	Each	$40,000	$160,000
Mag Meter - 4"	4	Each	$5,000	$20,000
Ductile Iron Piping - 24"	200	Lin. Ft.	$480	$96,000
Ductile Iron Piping Fittings	20	Each	$2,500	$50,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$50,000	$50,000
Electrical Connections	16	Each	$2,500	$40,000
MCC Sections	4	Each	$20,000	$80,000
Controls / SCADA Integration	1	Lump Sum	$60,000	$60,000
			TOTAL SLUDGE PUMPING	**$766,000**

CSO FACILITY UPGRADES

CSO Facility Capital Project	
Description	Total Probable Cost
SUMMARY	
GENERAL CONDITIONS	$307,348
SITE WORK	$290,000
RAW SEWAGE SCREENING	$493,000
GRIT TANKS UPGRADES	$186,900
CSO CLARIFIERS	$160,000
CHLORINE DISINFECTION	$348,000
Construction Sub-Total	$1,785,248
Contingency @ 15%	$267,787
Engineering @ 15%	$307,955
PROBABLE PROJECT COST:	**$2,360,990**

Description	Quantity	Unit	Unit Price	Total Probable Cost
GENERAL CONDITIONS				
Mobilization/Demobilization	1	Lump Sum	$5,000	$5,000
Supervision	5	Mo.	$24,000	$120,000
Record Drawing	1	Lump Sum	$5,000	$5,000
Bonds & Insurance (2%)	1	Lump Sum	$29,558	$29,558
Overhead and Profit (10%)	1	Lump Sum	$147,790	$147,790
			TOTAL GENERAL CONDITIONS:	**$307,348**
SITE WORK				
Paving Removal & Replacement (Full Depth)	1600	Sq. Yd.	$150	$240,000
Sidewalk	1000	Sq. Ft.	$15	$15,000
Silt Fence & SE/SC Control	1	Lump Sum	$20,000	$20,000
Restoration	1	Lump Sum	$15,000	$15,000
			TOTAL SITE WORK:	**$290,000**
RAW SEWAGE SCREENING				
Demo Existing Screens	1	Lump Sum	$25,000	$25,000
Concrete				
Cast in Screens	8	CY	$1,000	$8,000
Grout Slab	1	Lump Sum	$5,000	$5,000
Process				
New Bar Screen	1	Each	$325,000	$325,000
Mechanism Installation	1	Lump Sum	$40,000	$40,000
Walkways	1	Each	$20,000	$20,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$15,000	$15,000
MCC Sections	2	Each	$20,000	$40,000
Controls / SCADA Integration	1	Lump Sum	$15,000	$15,000
			TOTAL RAW SEWAGE SCREENING:	**$493,000**

GRIT TANKS UPGRADES				
Demo Existing Equipment	1	Lump Sum	$5,000	$5,000
Concrete				
Pad	1	Lump Sum	$2,000	$2,000
Process				
Blowers	3	Each	$20,000	$60,000
Blower Installation	1	Lump Sum	$6,000	$6,000
Air Header Piping	20	Lin. Ft.	$250	$5,000
Air Header Fittings	4	Each	$350	$1,400
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$7,500	$7,500
MCC Sections	4	Each	$20,000	$80,000
Controls / SCADA Integration	1	Lump Sum	$20,000	$20,000
		TOTAL GRIT TANKS UPGRADES		**$186,900**
CSO CLARIFIERS				
Containment	1	Lump Sum	$10,000	$10,000
Process				
Mechanisms Paint and Blast	2	Each	$75,000	$150,000
		TOTAL CSO CLARIFIERS:		**$160,000**
CHLORINE DISINFECTION				
Demolition of Existing Equipment	1	Lump Sum	$30,000	$30,000
Concrete				
Concrete Containment Wall & Pad	8	CY	$1,000	$8,000
Chemical Feed Storage Tank	1	Each	$30,000	$30,000
Chemical Feed System	1	Each	$50,000	$50,000
Chemical Feed Piping	1	Lump Sum	$35,000	$35,000
Chlorine Analyzer	4	Each	$5,000	$20,000
ORP Prob	4	Each	$2,500	$10,000
Electrical				
Conduit, Wiring, Labor	1	Lump Sum	$50,000	$50,000
MCC Sections	4	Each	$20,000	$80,000
Controls / SCADA Integration	1	Lump Sum	$35,000	$35,000
		TOTAL CSO DISINFECTION		**$348,000**

APPENDIX F
CONDITION ASSESSMENT SCHEDULE

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E. Appendix F – Condition Assessment Schedule

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Bar Screen Building													
Mechanical Bar Screen #1	2032	$ 270,000	$ 405,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mechanical Bar Screen #2	2032	$ 270,000	$ 405,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Washer	2026	$ 100,000	$ 150,000	$ -	$ 150,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Conveyor	2018	$ 75,000	$ 112,500	$ -	$ 112,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump Station													
Raw Sewage Pump #1	2043	$ 168,000	$ 252,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump #2	2043	$ 168,000	$ 252,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump #3	2043	$ 168,000	$ 252,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump Motor #1	2043	$ 70,000	$ 105,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump Motor #2	2043	$ 70,000	$ 105,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump Motor #3	2043	$ 70,000	$ 105,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump VFD Drive #1	2043	$ 108,000	$ 162,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump VFD Drive #2	2043	$ 108,000	$ 162,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Raw Sewage Pump VFD Drive #3	2043	$ 108,000	$ 162,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wet Well Drain Pump	2043	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grit Building													
Vortex Grit Washer #1	2025	$ 110,000	$ 165,000	$ -	$ -	$ -	$ -	$ -	$ 165,000	$ -	$ -	$ -	
Vortex Grit Washer #2	2025	$ 110,000	$ 165,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 165,000	$ -	$ -	$ -
Aeration Blower #1	2029	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000
Aeration Blower #2	2029	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000
Mag Meter - Raw Flows - 36"	2031	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grit Pump #1	2020	$ 15,000	$ 22,500	$ -	$ 22,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grit Pump #2	2020	$ 15,000	$ 22,500	$ -	$ 22,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Grit Removal Chamber #1	2025	$ 150,000	$ 225,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 225,000	$ -
Grit Removal Chamber #2	2025	$ 150,000	$ 225,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 225,000
Grit Blower Flow Meter	2025	$ 20,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -	$ -	$ -	$ -
Grit Blower Flow Meter	2025	$ 20,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -	$ -	$ -	$ -
Primary Clarifiers													
Primary Clarifier #1 Collector	2007	$ 175,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifier #1 Drive	2014	$ 75,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifier #1 Motor	1992	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifier #2 Collector	2007	$ 175,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifier #2 Drive	2019	$ 75,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifier #2 Motor	1992	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Primary Sludge													
Primary Sludge Pump #1	2022	$ 30,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Pump #2	2022	$ 30,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Grinder #1	2022	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Grinder #2	2022	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scum Pump #1	2022	$ 20,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scum Pump #2	2022	$ 20,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Air Compressor #1	2017	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Air Compressor #2	2017	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Mag Meter - 10"	2030	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Mag Meter - 10"	2030	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cabo Mag Meter - 24"	2024	$ 15,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Nitro Mag Meter - 24"	2024	$ 15,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Scum Concentrator/Compactor	2030	$ 150,000	$ 225,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Scum Wash Water Pump	2025	$ 20,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
UNOX System													
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #1	2002	$ 25,000	$ 37,500	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #2	2002	$ 25,000	$ 37,500	$ -	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #3	2002	$ 25,000	$ 37,500	$ -	$ -	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #4	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #5	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ 37,500	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #6	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ 37,500	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #7	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ 37,500	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #8	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 37,500	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #9	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 37,500	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #10	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 37,500
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #11	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #12	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #13	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #14	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #15	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #16	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #17	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #18	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #19	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #20	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #21	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #22	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #23	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #24	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #25	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #26	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #27	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #28	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 7.5/10 HP #29	2002	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #1	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #2	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #3	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #4	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #5	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #6	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #7	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #8	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 15/20 HP #9	2002	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #1	2002	$ 45,000	$ 67,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UNOX Mixer (Motor, Gearbox, Impeller) 25/30 HP #2	2002	$ 45,000	$ 67,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Pure Ox Supply Valve & Operator - 6" #1	1997	$ 7,500	$ 11,250	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #2	1997	$ 7,500	$ 11,250	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #3	1997	$ 7,500	$ 11,250	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #4	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #5	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #6	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #7	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #8	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -
Pure Ox Supply Valve & Operator - 6" #9	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -
Pure Ox Supply Valve & Operator - 6" #10	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250
Pure Ox Supply Iso Valve - 6" #1	1997	$ 7,500	$ 11,250	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #2	1997	$ 7,500	$ 11,250	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #3	1997	$ 7,500	$ 11,250	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #4	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #5	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #6	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #7	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -
Pure Ox Supply Iso Valve - 6" #8	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -
Pure Ox Supply Iso Valve - 6" #9	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -
Pure Ox Supply Iso Valve - 6" #10	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250
Pure Ox Waste Valve - 6" #1	1997	$ 7,500	$ 11,250	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #2	1997	$ 7,500	$ 11,250	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #3	1997	$ 7,500	$ 11,250	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #4	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #5	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #6	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -	$ -
Pure Ox Waste Valve - 6" #7	1997	$ 7,500	$ 11,250	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,250	$ -	$ -	$ -
Pure Ox Purge Blower #1	2007	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000	$ -	$ -
Pure Ox Purge Blower #2	2007	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000	$ -
Pure Ox Purge Blower #3	2007	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000
Pure Ox Purge Blower #4	2007	$ 30,000	$ 45,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pure Ox Purge Blower #5	2007	$ 30,000	$ 45,000	$ -	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifiers													
Intermediate Clarifier #1 Collector	1999	$ 175,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifier #1 Drive	2022	$ 60,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifier #1 Motor	1984	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifier #2 Collector	2007	$ 175,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifier #2 Drive	2014	$ 60,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Clarifier #2 Motor	1992	$ 10,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Telescoping Valves (6)	1999	$ 60,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Carbonaceous Return Activated Sludge													
Carbo Wasting Pump #1	2035	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Carbo Ras Return Flow Meter/Parshall Flume #1	2027	$ 50,000	$ 75,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 75,000	$ -	$ -
Carbo Ras Return Flow Meter/Parshall Flume #2	2027	$ 50,000	$ 75,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 75,000	$ -	$ -
Carbo RAS Pump #1	2017	$ 40,000	$ 60,000	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -
Carbo RAS Pump #2	2017	$ 40,000	$ 60,000	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -
Carbo RAS Pump #3	2017	$ 40,000	$ 60,000	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -
Carbo RAS Pump #4	2017	$ 40,000	$ 60,000	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Pump Station													
Intermediate Screw Pump #1	2044	$ 200,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Screw Pump #2	2007	$ 200,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Intermediate Screw Pump #3	2007	$ 200,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #1 Lower Bearing	2024	$ 25,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #2 Lower Bearing	2015	$ 25,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #3 Lower Bearing	2015	$ 25,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #1 Upper Bearing	2024	$ 35,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #2 Upper Bearing	2021	$ 35,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pump #3 Upper Bearing	2021	$ 35,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifiers													
Final Clarifier #1 Collector	2007	$ 250,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #1 Drive	2014	$ 60,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #1 Motor	1992	$ 10,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #1 Launder Covers	2037	$ 100,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #2 Collector	2007	$ 250,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #2 Drive	2016	$ 60,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #2 Motor	1992	$ 10,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #2 Launder Covers	2037	$ 100,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #3 Collector	2007	$ 250,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #3 Drive	2017	$ 60,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #3 Motor	1992	$ 10,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #3 Launder Covers	2037	$ 100,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #4 Collector	2007	$ 250,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #4 Drive	2017	$ 60,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #4 Motor	1992	$ 10,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier #4 Launder Covers	2037	$ 100,000	N/A - CIP Project	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Sludge Pump Station													
Nitro WAS Pump #1	2024	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Nitro WAS Pump #2	2024	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier RAS Waste Pump VFD #1	2024	$ 20,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -	$ -
Final Clarifier RAS Waste Pump VFD #2	2024	$ 20,000	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000	$ -	$ -
Nitro Mag Meter - 4"	2023	$ 5,000	$ 7,500	$ 7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Carbo Mag Meter - 4"	2023	$ 5,000	$ 7,500	$ 7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Thickener Refresh Water Mag Meter - 3"	2023	$ 5,000	$ 7,500	$ 7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Clarifier RAS Mag Meter - 10" #1	2023	$ 10,000	$ 15,000	$ -	$ -	$ -	$ -	$ 15,000	$ -	$ -	$ -	$ -	$ -
Final Clarifier RAS Mag Meter - 10" #2	2023	$ 10,000	$ 15,000	$ -	$ -	$ -	$ -	$ 15,000	$ -	$ -	$ -	$ -	$ -
Final Clarifier RAS Mag Meter - 10" #3	2030	$ 10,000	$ 15,000	$ -	$ -	$ -	$ -	$ 15,000	$ -	$ -	$ -	$ -	$ -
Final Clarifier RAS Mag Meter - 10" #4	2030	$ 10,000	$ 15,000	$ -	$ -	$ -	$ -	$ 15,000	$ -	$ -	$ -	$ -	$ -
Thickened Sludge Pump	2025	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Thickened Sludge Pump	2025	$ 40,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RAS Control Valve - 18" #1	1992	$ 25,000	$ 37,500	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RAS Control Valve - 18" #2	1992	$ 25,000	$ 37,500	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RAS Control Valve - 18" #3	1992	$ 25,000	$ 37,500	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RAS Control Valve - 18" #4	1992	$ 25,000	$ 37,500	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Thickened Sludge Mag Meter - 4" #1	2030	$ 5,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Thickened Sludge Mag Meter - 4" #2	2023	$ 5,000	$ 7,500	$ 7,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tertiary Treatment Building													
Disc Filter No. 1	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disc Filter No. 2	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disc Filter No. 3	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disc Filter No. 4	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disc Filter No. 5	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disc Filter No. 6	2037	$ 500,000	$ 750,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disinfection Building													
UV Disinfection Unit #1	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #2	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #3	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #4	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #5	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #6	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #7	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
UV Disinfection Unit #8	2037	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Non-Pot Pump #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Non-Pot Pump #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Non-Pot Pump #3	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Effluent Flow Meter	2026	$ 40,000	$ 60,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 60,000	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Gravity Sludge Thickener													
Gravity Sludge Thickener Cover	2007	$ 175,000	$ 262,500	$ -	$ -	$ 262,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gravity Sludge Thickener Collector	2007	$ 125,000	$ 187,500	$ -	$ -	$ 187,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gravity Sludge Thickener Drive	2014	$ 60,000	$ 90,000	$ -	$ -	$ 90,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gravity Sludge Thickener Motor	1992	$ 10,000	$ 15,000	$ -	$ -	$ 15,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digesters													
Anaerobic Digester Cover #1	2035	$ 250,000	$ 375,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Cover #2	2035	$ 200,000	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Cover #3	2035	$ 200,000	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Waste Gas Burner	2035	$ 200,000	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Boiler #1	2035	$ 180,000	$ 270,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Boiler #2	2035	$ 180,000	$ 270,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Mixing Pump #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Mixing Pump #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Mixing Pump #3	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Mixing Pump #4	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Sludge Circulation Pump #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Sludge Circulation Pump #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Anaerobic Digester Sludge Circulation Pump #3	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Grinder #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Grinder #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Grinder #3	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Grinder #4	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Grinder #5	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Belt Filter Press Feed Pump #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Belt Filter Press Feed Pump #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Transfer Pump #1	2030	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Transfer Pump #2	2030	$ 35,000	$ 52,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sludge Thickening/Dewatering													
Gravity Belt Thickener	2023	$ 400,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Mixing Unit #1	2033	$ 35,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Mixing Unit #2	2033	$ 35,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Belt Filter Press #1	2011	$ 350,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Belt Filter Press #2	2011	$ 350,000	*N/A - CIP Project*	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Transfer Pump #1	2018	$ 30,000	N/A	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Transfer Pump #2	2018	$ 30,000	N/A	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Transfer Pump #3	2018	$ 30,000	N/A	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Day Tanks #1	2033	$ 20,000	N/A	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Polymer Day Tanks #2	2033	$ 20,000	N/A	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	Replacement Year	Equipment Cost	Replacement Cost	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
Generator Building													
Switchgear Battery Array	2030	$ 200,000	$ 300,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Generator #1	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Generator #2	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Generator #3	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas Generator #1	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas Generator #2	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Natural Gas Generator #3	2030	$ 225,000	$ 337,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #1	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #2	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #3	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #4	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #5	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Radiator Drive Motor #6	2030	$ 30,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Aftercooler #1	2030	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Aftercooler #2	2030	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Aftercooler #3	2030	$ 25,000	$ 37,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Co-Gen System Boost Transformer	2030	$ 100,000	$ 150,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cryo Plant - Not In Service													
Nitrification Basins - Not In Service													
Backwash Holding Tank - Not In Service													
		$ 18,950,500	**$ 20,558,250**	**$ 296,250**	**$ 423,750**	**$ 626,250**	**$ 311,250**	**$ 131,250**	**$ 296,250**	**$ 296,250**	**$ 315,000**	**$ 330,000**	**$ 450,000**
			Inflation-Adjusted (2.92%):	$ 304,901	$ 448,858	$ 682,727	$ 349,228	$ 151,565	$ 352,093	$ 362,374	$ 396,560	$ 427,575	$ 600,082

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