City of Saint Charles

West Side Water Reclamation Facility

2015 Facility Plan Update

Continuity • Collaboration • Commitment

November, 2015

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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
$FeCl_3$	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
NH_3-N	ammonia nitrogen
NO_2	nitrite
NO_3	nitrate
NPDES	National Pollutant Discharge Elimination System
NPW	non-potable water
O_2	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

INTRODUCTION AND BACKGROUND

The City of St. Charles is served by two wastewater treatment facilities, the Main Wastewater Treatment Facility (MWWTF) and the West Side Water Reclamation Facility (WSWRF). The collection system tributary to the West Side Water Reclamation Facility consists of approximately 16.3 miles of sanitary sewers, 1.2 miles of force main and 3 lift stations. The West Side Water Reclamation Facility (West Side WRF) is located at 3803 Illinois Route 38. The St. Charles Facility Planning Area (FPA) is comprised of approximately 10,340 acres, of which 2,023 acres are tributary to the West Side WRF.

The West Side Water Reclamation Facility (West Side WRF) has a design average treatment capacity of 0.70 MGD. The facility generally serves the community's wastewater needs west of Randall Road and discharges to Mill Creek.

The City's National Pollutant Discharge Elimination System (NPDES) Permit for the West Side WRF (Permit No. IL0026808), as administered by the Illinois Environmental Protection Agency (IEPA), was last issued on June 7, 2012 and expires on May 31, 2017. The NPDES permit is included as Appendix A.

The purpose of this study is two-fold and will include a comprehensive Facility Plan Report as well as a Phosphorus Removal Feasibility Report. The intent of the reports is to identify process upgrades and rehabilitation projects which should be incorporated into the City's five year Capital Improvements Program, as well as address long-range needs of the community

While the West Side WRF is not currently a major discharger to Mill Creek, the NPDES permit will have phosphorus limits after the next expansion to 1.05 MGD. Therefore, it is in the City's best interest to determine the impacts these nutrient limits will have on the cost and design of this expansion.

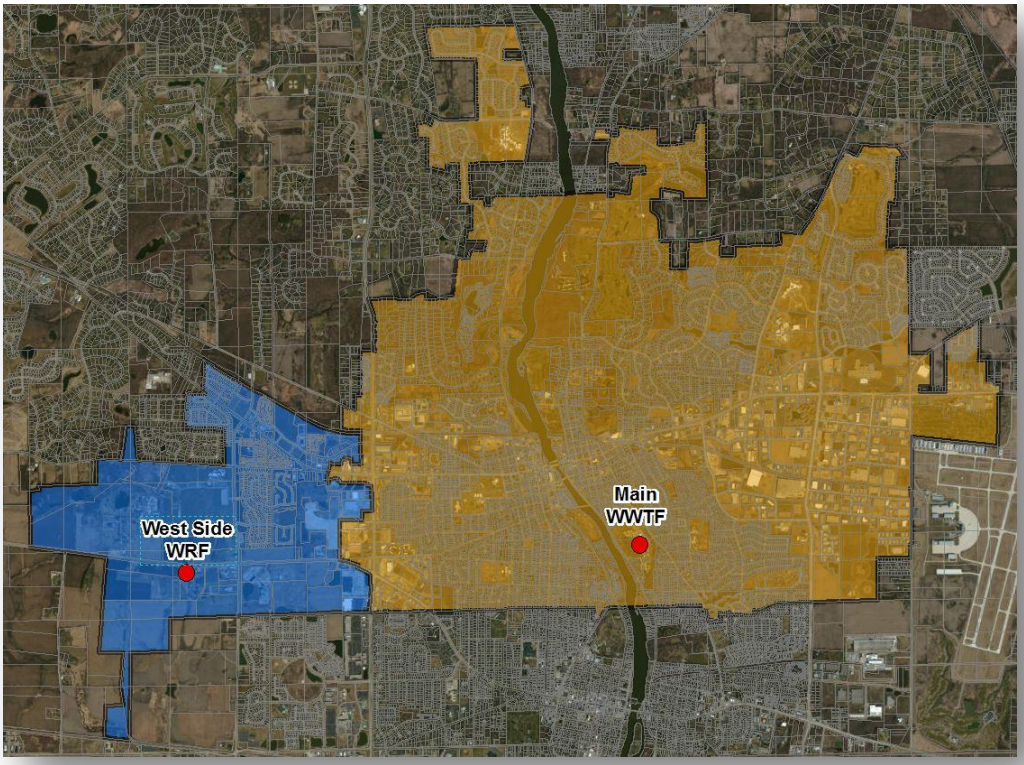
The purposes of the Phosphorus Removal Feasibility Study are:

- Develop and evaluate chemical and biological phosphorus removal alternatives for achieving effluent limits of 1.0 and 0.5 mg/L
- Present costs to implement and operate the selected alternative(s)

THE COMMUNITY'S NEEDS

The City of St. Charles, Kane County, Illinois is located along the Fox River between Geneva and South Elgin. In 1989, the City of St. Charles was approached for service by properties west of Randall Road requesting annexation and sanitary sewer service. In response, a Facilities Plan Amendment and Facilities Planning Area Boundary Change were submitted and approved by the Northeastern Illinois Planning Commission to extend the City of St. Charles Service Area west of Randall Road. It was determined at that time that the properties located within this area would be tributary to the existing Illinois Department of Corrections wastewater treatment facility located on Illinois Route 38 west of Peck Road. This wastewater treatment facility was subsequently purchased by the City of St. Charles and renamed the West Side Water Reclamation Facility (WRF).

Exhibit 1 | Facility Planning Area (FPA)



In 2010, the U.S. Census Bureau estimated that the City of St. Charles served a total residential population of 32,974. The residential usage based on billing records was 2,221,446 gallons per day. This residential usage consumed by an estimated 32,974 people equates to 67.37 gallons per capita per day (gcd).

The population equivalents (PE) of the West Side Service Area were established by reviewing the City's water and sewer billing records. The West Side Service Area served 6,275 PE in 2013 and the West Side WRF treated 0.49 MGD of wastewater. Taking into consideration ongoing development, governmental capacity commitments, and potential annexations, the population equivalent of the service area will eventually be increased by 6,111 PE. This equates to a build-out projection of 12,386 PE at an average daily flow (ADDF) of 1,110,000 gal/day or 1.11 MGD.

Table 1 | Projected Population and Wastewater Flows

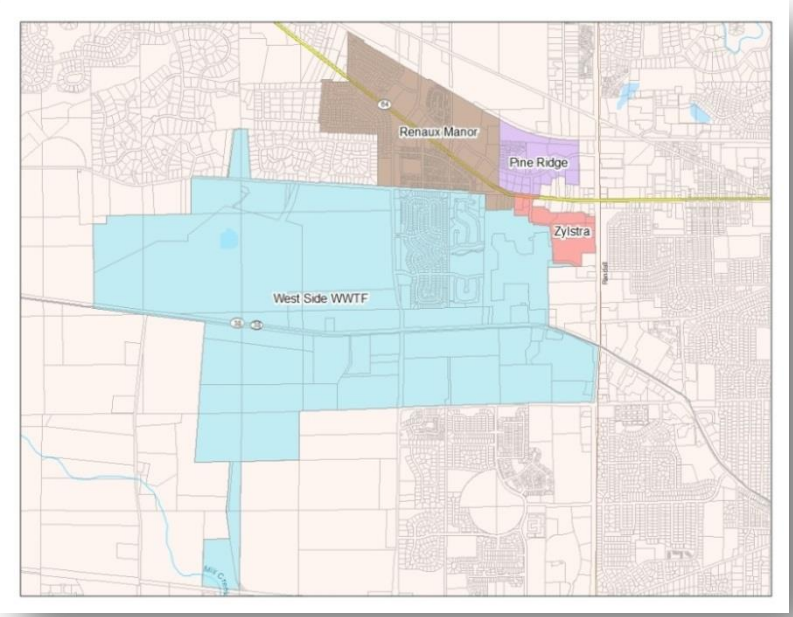
Description	2013 Conditions		Current Development		Build-Out Projection	
	PE	ADDF (MGD)	PE	ADDF (MGD)	PE	ADDF (MGD)
Renaux Manor Basin	1,758	0.14	414	0.04	3,320	0.29
Pine Ridge Basin	11	0.001	65	0.006	326	0.03
Zylstra Basin	280	0.02	0	0.00	320	0.04
Gravity Basin	4,226	0.33	0	0.00	8,420	0.75
Total	**6,275**	**0.49**	**479**	**0.046**	**12,386**	**1.11**
Peaking Factor		3.15		3.98		2.86
Peak Hourly Flow (MGD)		**1.54**		**0.18**		**3.18**

The current West Side WRF has a capacity of 700,000 gallons per day (0.70 MGD). The 2013 wastewater projections for this service area are 487,350 gallons per day. This value includes 40,832 gpd committed for increased flow from the Department of Corrections that the City agreed to when the West Side WRF was purchased. Therefore, the remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. Current development will create an average daily flow of approximately 0.54 MGD, and not require the expansion of the West Side WRF. However, build-out conditions will require expansion. When the average influent approaches 80% of its design flow, or 0.56 MGD, it is recommended that the City begin planning for the expansion of the West Side WRF.

COLLECTION SYSTEM

The City of St. Charles wastewater collection system includes two service areas generally divided by Randall Road. The sanitary sewers west of Randall Road are tributary to the West Side Water Reclamation Facility (WRF). This service area is relatively new and the sewers have been constructed with modern materials, which minimize infiltration and inflow.

Exhibit 3-2 | West Side WRF Service Area Drainage Basins



The majority of the existing sanitary sewers within the West Side WRF's collection system are less than fifteen years old. Most of these properties consist of newer residential neighborhoods and commercial developments constructed with PVC sewer pipe. The exception would be the sewers contained within the Illinois Youth Center are maintained by the Department of Corrections. These sewers were originally installed in the 1960's and are generally constructed of clay pipe. The 1998 Facility Plan Amendment identified that the sanitary sewer system which serves the Illinois Youth Center had historically been subject to high infiltration and inflow (I/I) which is often found in older areas that contain clay sewer pipe. As a condition of the purchase agreement for the wastewater treatment facility, the Department of Corrections conducted an evaluation of the existing sanitary sewer system to identify and remove infiltration and inflow sources to the collection system. From this evaluation it was determined that the I/I was limited primarily to direct inflow which was substantially reduced through the improvements made throughout the evaluation.

The City of St. Charles' Finance Department maintains its GASB 34 Report, however, the collection system is not broken out by treatment facility. Therefore the actual value of this asset for the Main Service Area is not known. It has been estimated that the City currently maintains 172 miles of sanitary sewer mains (gravity and force main), as well as roughly 4,040 sanitary manholes and 13 lift stations in the Main Service Area. Using estimated replacement unit costs for sanitary sewer pipes and sanitary manholes, the City owns and maintains a $220 million dollar gravity collection system. Assuming 10% for contingency and 15% for design and administration, the replacement of the entire collection system is estimated to cost approximately $275 million. However, the majority of the collection system is not in need of replacement.

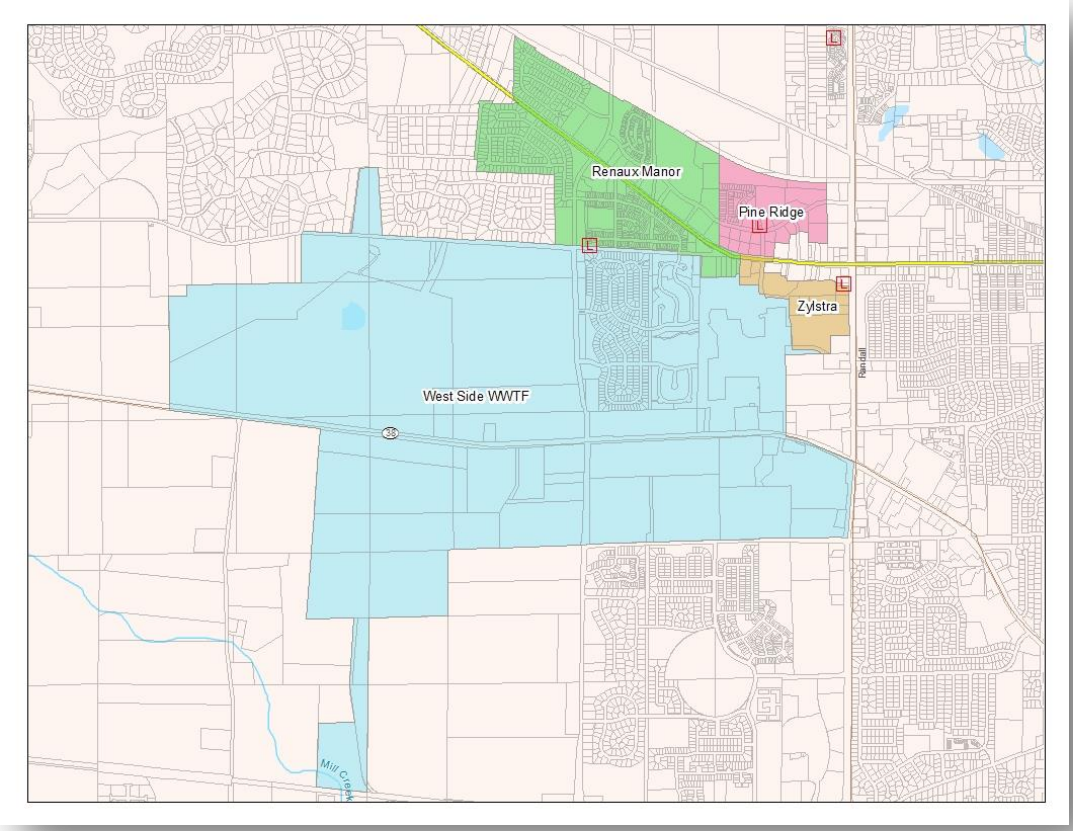
The service life of a collection system is approximately 75 years, and this life can be extended by approximately 25 years with ongoing maintenance and rehabilitation. Based on straight-line depreciation over this 100-year service life, it is recommended that the City reinvest $2,751,000 annually toward sanitary sewer collection system rehabilitation and replacement.

Approximately 20% of the collection system is already beyond its 75-year service life, and may be considered fully depreciated and in need of replacement. It is recommended that the City reinvest $1,403,000 annually toward the replacement of sewers that were installed before 1941 (as a portion of the annual reinvestment). It is also recommended that the remainder of the annual reinvestment be applied to the CMOM Program. There are several initial costs involved with starting up a program of this magnitude (within the first year of the program). This cost is estimated to be roughly $550,000. In order to sustain the long-term viability of the sewer utility, the City's sewer rehabilitation budget should be raised to the aforementioned level.

LIFT STATIONS

The City of St. Charles' Main Service Area includes thirteen lift stations, three of which are within the West Side Service Area. These installations are reasonably new and have been constructed as the City has grown over the past 15 years. The locations of these lift stations are indicated in the map below.

Exhibit 3 | West Side Service Area Lift Stations



The lift stations vary in age and capacity, but were all constructed after 1998 as the City developed further west. It should be noted that the figures in the table below do not include the engineering and contingencies that would be involved in a rehabilitation or replacement project. The value of the City's lift station and force main assets is approximately $2,160,000. Based on a straight-line depreciation over the design life of the equipment, structures and force mains, the City should be reinvesting around $65,000 annually toward maintaining and replacing these assets within the West Side Service Area.

Table 2 | Lift Station Asset Value

Lift Station	Equipment	Structure	Force Main	Totals
Pine Ridge	$210,000	$185,000	$110,000	$505,000
Renaux Manor	$250,000	$215,000	$382,000	$847,000
Zylstra	$210,000	$185,000	$409,000	$804,000
Totals	$670,000	$585,000	$901,000	$2,156,000
Design Life, Years	20	50	50	
Annual Replacement	$33,500	$11,700	$18,020	**$63,220**

EXISTING WEST SIDE WATER RECLAMATION FACILITY

In 1989, the City of St. Charles was approached by property owners west of Randall Road requesting annexation and sanitary sewer service. In response, the City investigated several alternatives including the acquisition of the Department of Corrections wastewater treatment facility, which served the Illinois Youth Center and the Illinois Department of Transportation's garage. The treatment facility included a 0.35 MGD package treatment plant, polishing pond and sludge drying beds. Effluent from the facility was discharged to Mill Creek near Keslinger Road.

The City submitted a Facility Plan Amendment and request for Facility Planning Area Boundary change in late 1989 and an update in 1991. The boundary change and plan were approved by NIPC and Illinois EPA. The City commenced with Phase I in 1992, which included purchase of the treatment facility and upgrading the facility to meet NPDES standards. Phase I was completed in 1997.

The City updated the Facility Plan again in 1998. The update outlined a phased approach for expansion of the treatment facility, which expanded the plant's capacity in three 0.35 MGD increments. The Illinois EPA approved Phases II and III as recommended with the Facility Plan, which would increase the treatment facility's capacity to 1.05 MGD. However, the Illinois EPA requested that a Facility Plan Update be submitted prior to expansion of the plant to 1.4 MGD to verify capacity requirements. The Illinois EPA issued an NPDES Permit consistent with the recommendations allowing for the Phase II expansion to 0.70 MGD and Phase III expansion to 1.05 MGD.

Once the Facility Plan was approved, the City of St. Charles proceeded with design and construction of the Phase II Improvements. The project was completed in 2001 and funded through the Illinois EPA Revolving Loan Program.

The City updated the Facility Plan again in 2008. This update incorporated phased approach for expansion of the treatment facility as well as an analysis of recently promulgated and pending environmental regulations. The regulatory issues included nutrient removal, suspended solids effluent requirements and bio-solids stabilization, as well as anti-degradation requirements and copper and radium concentrations in the effluent.

UPGRADE AND EXPANSION PLAN

The service area continues to be developed in accordance with the City's Comprehensive Plan. The West Side WRF is operating at approximately 69% of its design capacity. The City has committed to serve the Department of Corrections which equates to 40,832 gpd, or an additional 6%. Therefore, the total committed capacity is 75% of design. The Illinois EPA places facilities over 80% of design on Critical Review to ensure that permitting does not exceed design capacity. Once the influent flow and outstanding permits reach 100% of the design capacity, the facility is placed on Restricted Status and additional connections will not be permitted until the facility has been expanded. The City of St. Charles has approximately 318 PE remaining prior to being placed on Critical Review, and approximately 1,718 PE remaining prior to being placed on Restricted Status.

The City has several options for the chemical precipitation of phosphorus. The calculated dosing requirements for secondary treatment equate to a daily usage of approximately 95 gallons. This is approximately 4 gallons per hour, which may vary throughout the day due to the extremely low influent flows overnight. The capital cost estimate and annual cost analysis for implementing chemical phosphorus removal to attain a 1.0 mg/L limit are shown below.

Table 3 | Probable Costs for Chemical Phosphorus Removal to 1.0 mg/L

GENERAL CONDITIONS	$126,000
SITE WORK	$134,000
CHEMICAL FEED SYSTEM	$485,130
CONSTRUCTION SUBTOTAL	$745,130
CONTINGENCY @ 20%	$149,026
CONSTRUCTION TOTAL	$894,156
PROJECT ENGINEERING (14%)	$125,182
TOTAL PROJECT COST	$1,019,338

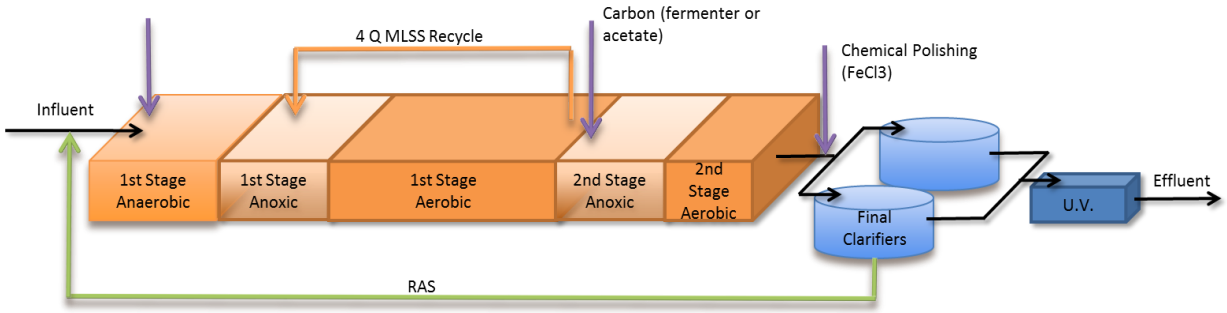
Table 4 | Chemical Cost Analysis for TP = 1.0 mg/L

DAF (MGD)	Phosphorus (Lbs/day)	Phosphorus (Lbs/ Year)	FeCl3 (Gallons/year)	Estimated Annual Cost
1.05	53	19,345	34,821	$34,821

In 2004, the Illinois EPA implemented additional nutrient removal criteria for wastewater treatment facilities that were proposing expansion of hydraulic capacity. Two nutrients of concern are total nitrogen (TN) and total phosphorus (TP). At this time, the anticipated limits are 8 mg/L and 1 mg/L for TN and TP, respectively. The most common application for nitrogen removal includes the incorporation of anoxic zones into the biological process. This approach to wastewater treatment is called Biological Nutrient Removal (BNR).

Several BNR processes were evaluated for the West Side WRF. The A^2/O and Five-Stage Bardenpho are considered to be the top two candidates for BNR at the West Side WRF. The A^2/O is simpler to implement, while the Five-Stage Bardenpho provides increased flexibility and lower TN. The anticipated effluent TN limit is 8 mg/L. If the A^2/O is designed with an internal recycle capacity of 6Q, both processes can meet this limit. The TN limit could be 5 mg/L in the future, and the Bardenpho will then be the more applicable process. For the purposes of this report, the Bardenpho is the selected alternative

Exhibit 4 | West Side WRF – Five-Stage Bardenpho Process



The City's current aerobic digestion and land application system is consistent with current regulations. While the West Side Services area does not include any known sources that would prevent the City from upgrading the process to meet Class A EQ Bio-solids, the cost of pursuing this classification cannot be justified at this time. Therefore it is recommended that the City continue to utilize the existing aerobic digestion process.

The West Side Water Reclamation Facility's current capacity is 0.70 MGD. The facility was designed to be expanded in 350,000 gallon per day increments with an ultimate capacity of 1.4 MGD. Phase III would increase the facility's capacity from 0.7 MGD to 1.05 MGD.

Phase III will include the addition of one raw sewage pump, upgrade of the biological process for expansion and removal of TN and TP, construction of an additional tertiary clarifier or construction of tertiary filters, upgrade of the aerobic digestion process, and the addition of on-site sludge dewatering and 150 days ultimate sludge storage capacity.

The probable cost for the alternative which included tertiary filtration was $12.2 Million, while the total estimated cost for the alternative that included tertiary clarification was $11.1 Million. The City has not yet determined which alternative best fits the community's needs. The City decided to structure its economic model on the higher cost alternative (filtration), but intends to further evaluate each alternative during preliminary design. The City has elected to construct the improvements in smaller phases. Phase III-A will address the immediate capacity and regulatory issues while Phase III-B will include construction of the sludge dewatering, sludge storage facilities and others.

Table 5 | Phase III-A and III-B Probable Costs

	Total	Phase 3A	Phase 3B
GENERAL CONDITIONS	$682,000	$477,400	$204,600
SITEWORK	$642,100	$416,400	$225,700
RAW SEWAGE PUMP STATION	$55,000	$55,000	$0
HEADWORKS	$151,000	$0	$151,000
BIOLOGICAL PROCESS	$1,758,437	$1,758,437	$0
TERTIARY FILTERS/ CHEM FEED	$2,495,570	$2,495,570	$0
RAS PUMP STATION	$76,000	$76,000	$0
AEROBIC DIGESTION	$170,800	$170,800	$0
SLUDGE HANDLING BUILDING	$1,415,655	$0	$1,415,655
SLUDGE STORAGE BARN	$989,453	$494,726	$494,726
SUBTOTAL CONSTRUCTION	$8,436,015	$5,944,334	$2,491,681
CONTINGENCY 20%	$1,687,203	$1,188,867	$498,336
CONSTRUCTION TOTAL	$10,123,218	$7,133,201	$2,990,017
ENGINEERING 14%	$1,417,251	$998,648	$418,602
PROJECT TOTAL (2007)	$11,540,469	$8,131,849	$3,408,620
PROJECT TOTAL (2015)	$12,212,345	$8,605,278	$3,607,067

The total annual cost for operations, maintenance and replacement for the West Side WRF is approximately $1.3 Million. 53% of this amount is dedicated to the replacement account, while the estimated usage at start-up is 596,000 gallons per day.

SECTION 1

INTRODUCTION AND BACKGROUND

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1. INTRODUCTION AND BACKGROUND

1.1 GENERAL BACKGROUND

The City of St. Charles is located along the Fox River in central Kane County approximately 35 miles east of downtown Chicago. The City is bordered by the Village of South Elgin to the north, the City of West Chicago to the east, the City of Geneva to the south and the Village of Campton Hills to the west.

The City owns and operates a sanitary sewer collection system and two wastewater treatment facilities: the Main Wastewater Treatment Facility and the West Side Water Reclamation Facility. The collection system tributary to the West Side Water Reclamation Facility consists of approximately 16.3 miles of sanitary sewers, 1.2 miles of forcemain and 3 lift stations. The West Side Water Reclamation Facility (West Side WRF) is located at 3803 Illinois Route 38. The St. Charles Facility Planning Area (FPA) is comprised of approximately 10,340 acres, of which 2,023 acres are tributary to the West Side WRF.

The West Side Water Reclamation Facility (West Side WRF) has a design average treatment capacity of 0.70 MGD. The facility generally serves the community's wastewater needs west of Randall Road and discharges to Mill Creek.

The Main Wastewater Treatment Facility (Main WWTF) is located at the Public Works Facility, 1405 S. 7th Avenue on the eastern shore of the Fox River, approximately nine-tenths of a mile south of the Illinois Route 64 Bridge. The Main WWTF plant has a design average treatment capacity of 9.0 million gallons per day (MGD). The facility generally serves the community's wastewater needs east of Randall Road and discharges to the Fox River. The Main WWTF and the area that it serves is presented in a separate report titled "City of St. Charles 2015 Facility Plan Update – Main Wastewater Treatment Facility".

The City's National Pollutant Discharge Elimination System (NPDES) Permit for the West Side WRF (Permit No. IL0026808), as administered by the Illinois Environmental Protection Agency (IEPA), was last issued on June 7, 2012 and expires on May 31, 2017. The NPDES permit is included as Appendix A.

1.2 STUDY PURPOSE AND SCOPE

The purpose of this study is two-fold and will include a comprehensive Facility Plan Report as well as a Phosphorus Removal Feasibility Report. The intent of the reports is to identify process upgrades and rehabilitation projects which should be incorporated into the City's five year Capital Improvements Program, as well as address long-range needs of the community.

1.2.1 Facility Plan Report

A Facility Plan Report (FPR) is a management and planning document used to identify, evaluate, and plan required wastewater facility improvements. It provides an assessment of the collection and treatment systems' abilities to meet both current and future loads, flows and regulatory requirements and provides critical information for improvements to correct current or projected deficiencies. FPRs are required by the Illinois Environmental Protection Agency (IEPA) for any wastewater improvements that change the treatment process or expand the capacity of the wastewater treatment plant.

FPRs are typically updated every five to ten years, or when significant changes in growth or regulatory requirements have occurred or are expected. In 1998, the City updated its FPR which outlined a phased approach for expansion of the treatment facility in three 0.35 MGD increments. The Illinois EPA approved Phases II and III as recommended within the FPR which would increase the treatment facility's capacity from 0.35 MGD to 1.05 MGD. The IEPA issued an NPDES Permit consistent with the recommendations allowing for the Phase II expansion to 0.70 MGD and Phase III expansion to 1.05 MGD.

Once the Facility Plan was approved, the City of St. Charles proceeded with design and construction of the Phase II Improvements. The project completed in 2001 and funded through the Illinois EPA Revolving Loan Program. The community has continued to grow in accordance with the Comprehensive Plan and 1998 Facility Plan. The purposes of this FPR are 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 and identify requirement maintenance repairs/replacements;
- 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 system;
- Identify and evaluate alternatives to address both current and future deficiencies;
- Recommend cost effective alternatives; and
- Present costs, user fee analysis, implementation plans, cash flow projections and environmental impacts of the recommended alternatives.

1.2.2 Phosphorus Removal Feasibility Study

The City of St. Charles has been a longstanding member of the Fox River Study Group, which has been evaluating the water quality impairments associated with the river since the early 2000's. In recent years, the IEPA has been receiving increased pressure from the USEPA to implement stricter nutrient standards on rivers and streams in Illinois which are impaired for dissolved oxygen. The Fox River Study Group, collectively with the municipalities, has negotiated language for the special conditions to be incorporated into the next round of NPDES permits.

The City of St. Charles was the first POTW to receive a draft permit with the special conditions incorporated for the Main WWTF. The City has reviewed and discussed these issues with the IEPA and anticipates issuance of the final NPDES permit in the near future. The special conditions include language that requires the submittal of a Feasibility Study to lower the effluent phosphorous concentration to 1.0 mg/l as well as 0.5 mg/l. This Feasibility Study must be completed and submitted to the IEPA within twelve months after issuance of the permit. Another special condition requires that the City of St. Charles study, design and construct improvements which will allow the plant to achieve a 1 mg/l effluent phosphorous limit within 36 months after issuance of the permit.

While the West Side WRF is not currently a major discharger to Mill Creek, the NPDES permit will have phosphorus limits after the next expansion to 1.05 MGD. Therefore, it is in the City's best interest to determine the impacts these nutrient limits will have on the cost and design of this expansion.

The purposes of the Phosphorus Removal Feasibility Study are:

- Develop and evaluate chemical and biological phosphorus removal alternatives for achieving effluent limits of 1.0 and 0.5 mg/L
- Present costs to implement and operate the selected alternative(s)

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SECTION 2

THE COMMUNITY'S NEEDS

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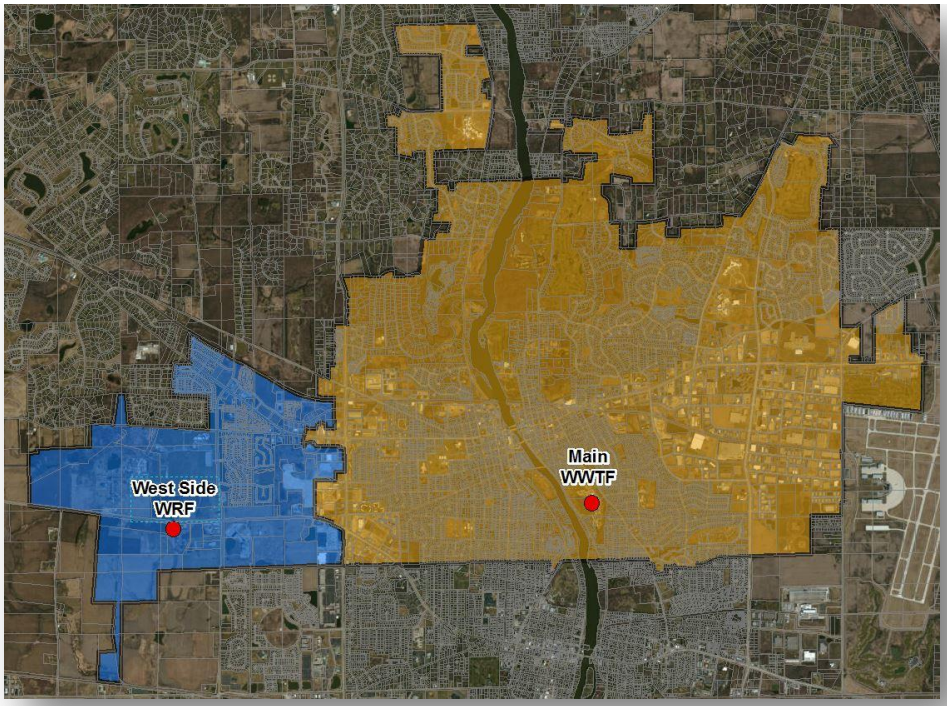
2. THE COMMUNITY'S NEEDS

2.1 GENERAL BACKGROUND

The City of St. Charles, Kane County, Illinois is located along the Fox River between Geneva and South Elgin. In 1989, the City of St. Charles was approached for service by properties west of Randall Road requesting annexation and sanitary sewer service. In response, a Facilities Plan Amendment and Facilities Planning Area Boundary Change were submitted and approved by the Northeastern Illinois Planning Commission to extend the City of St. Charles Service Area west of Randall Road. It was determined at that time that the properties located within this area would be tributary to the existing Illinois Department of Corrections wastewater treatment facility located on Illinois Route 38 west of Peck Road. This wastewater treatment facility was subsequently purchased by the City of St. Charles and renamed the West Side Water Reclamation Facility (WRF).

Exhibit 2-1 | Facility Planning Area (FPA)



The West Side WRF serves the area of St. Charles west of Randall Road including the Illinois Youth Center and the Kane County Judicial Center, commonly referred to as the West Side Service Area.

2.2 EXISTING POPULATION PROJECTIONS AND WATER DEMANDS

In order to accurately evaluate the current and future wastewater capacity needs, we established the current number of users, the users which are permitted or approved but not currently contributing and the potential population from the remaining open lands in the FPA.

In 2010, the U.S. Census Bureau estimated that the City of St. Charles served a total residential population of 32,974. The residential usage based on billing records was 2,221,446 gallons per day. This residential usage consumed by an estimated 32,974 people equates to 67.37 gallons per capita per day (gcd).

The population equivalents (PE) of the West Side Service Area were established by reviewing the City's water and sewer billing records. The City of St. Charles billed an average of 344 thousand gallons per day during 2011 and 2013 within the West Side Service Area (2012 data was disregarded due to dry weather conditions). Based on a water consumption rate of 67.37 gcd, the population equivalent served with water was 5,101 PE.

Taking into account metered influent from 2011 and 2013, the West Side WRF treated an average flow of 487,350 gallons per day or 0.487 MGD. The Illinois Youth Center (IYC) is served by a private water system but discharges wastewater to the West Side WRF, which is metered and equated to 79,723 gpd. Well #13 at the Oak Street Water Filtration Facility discharges backwash wastewater to the Zylstra sub-basin of the West Side Service Area. Wastewater from the Oak Street facility is estimated to be 10,260 gpd by the City Water Department. The IDOT Facility at the corner of IL Route 38 and Peck Road is also served by a private water system but discharges an estimated 1,000 gpd wastewater to the West Side WRF.

487,350 gpd – 79,723 gpd – 10,260 gpd – 1,000 gpd =396,367 gpd

Therefore, the average daily wastewater received from the City's water users is 396,367 gpd or 77.70 gcd. Therefore the West Side Service Area contains roughly 6,275 PE.

Table 2-1 | Current Population, Water Demands and Wastewater Flows

	Residential	Non-Residential	Total
Number of Customers	1,202	55	1,257
Population Equivalents	3,050 PE	2,051 PE	5,101 PE
Water Usage Billed	0.21 MGD	0.14 MGD	0.35 MGD
Water Usage / PE	67.37 gcd	67.37 gcd	67.37 gcd
Wastewater Received From Water Users	0.24 MGD	0.16 MGD	0.40 MGD
Wastewater / PE	77.70 gcd	77.70 gcd	77.70 gcd

The future population projection, which is the ultimate buildout of properties within the FPA, was developed by assigning PE values to the planned development and remaining open lands in accordance with the Land Use Plan.

Future Population Equivalent

Total Current PE	6,275	PE
Additional PE at Build-Out of Service Area	6,111	PE
Total Future PE	**12,386**	**PE**

2.3 INFILTRATION AND INFLOW

2.3.1 Infiltration

The USEPA considers average annual infiltration to be excessive if it exceeds 50 gcd. The current estimated population equivalent within the West Side WRF's service area is 5,101 PE. We have estimated the amount of infiltration by comparing the water usage records with the plant effluent records. The average water usage per population equivalent is 67.37 gcd. The average wastewater received per population equivalent is 77.70 gcd. The differential is approximately 10.33 gcd, which is 21% of the USEPA's criteria. As the system ages it is anticipated that the infiltration will increase due to pipe degradation, however at this time the system is tight and the City doesn't experience large amount of infiltration.

Based on wastewater flow data from the summer of 2012, the base flow during drought conditions where infiltration is minimized was about 64 gcd. Based on total current PE and the USEPA definition of excess infiltration (120 gcd during periods of high groundwater), the West Side WRF experiences excess infiltration when flows exceed 0.75 MGD.

2.3.2 Inflow

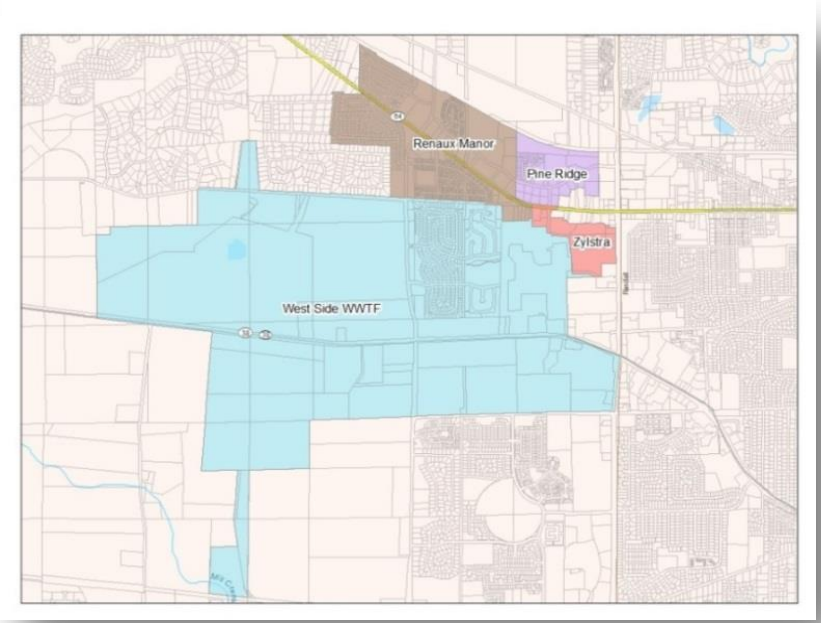
The USEPA considers inflow to be excessive in separate sanitary sewer systems if the total flow, water usage plus infiltration plus inflow, exceeds 275 gcd. Based on wastewater flow data from the summer of 2012, the base flow during drought conditions where infiltration is minimized is about 64 gcd. Based on total current PE and the USEPA definition of excess infiltration (275 gcd during storm events where there are no basement back-ups), the West Side WRF experiences excess inflow when flows exceed 1.72 MGD.

2.4 FUTURE POPULATION PROJECTIONS

In order to accurately evaluate the City's future wastewater demands for the West Side WRF Service Area, the following data was reviewed and established:

- Estimated future users (determined from information regarding developments currently under construction or approved by the City of St. Charles).
- Potential number of users from the remaining undeveloped properties located within the boundaries of the City's current and future service area.

Exhibit 2-2 | West Side Service Area Basins



The West Side Service Area currently contains four drainage basins. Each drainage basin was analyzed to establish the 2013 Conditions and Build-Out Population Equivalents

2.4.1 Reneaux Manor Drainage Basin

The Renaux Manor Drainage Basin is tributary to the Renaux Manor Lift Station located on Campton Hills Drive. This service area encompasses the land that is north of Campton Hills Drive and west of the intersection with Route 64. From the most recent water billing records, this area was estimated to use 118,419 gallons per day, which equates to 1,758 PE.

In 2013, there were 18 lots classified as vacant residential areas by Kane County (shown in red). These vacant lots equate to approximately 63 PE, which will be considered for build-out conditions.

Exhibit 2-3 | Renaux Manor Drainage Basin

There are also multiple properties within the City's corporate boundary that are currently not served by public sewers. These properties are expected to be served in a build-out condition. The following table provides a breakdown of the previously mentioned properties. It is estimated that these areas (shown in green) would add 351 PE which would produce 35,100 gallons per day of wastewater. This equates to a build-out total of 2,172 PE with a projected average daily flow of 177,962 gallons per day or 0.18 MGD.

Table 2-2 | Renaux Manor Current Development

Description	Additional PE	Wastewater (gpd)
Vacant Residential Areas	63	6,300
Corporate Reserve – 34.38 acre area currently containing privately served commercial properties for future service at a density of 12 PE per acre. The effective area taken was 85% of the total area to account for non-developable land	351	35,100
Total	**414**	**41,400**

It should be noted that there are also several existing developments located directly outside of the corporate boundary that may require service in the future as determined by the City's Community Development Department. These properties are currently served through private septic systems but could potentially be annexed to the City and served by the West Side WRF

Exhibit 2-4 | Reneaux Manor – Potential Annexations

The above referenced developments are detailed in the following table and could add roughly 1,148 PE or 114,800 gal/day to the service area. The future development and potential annexations would increase the build-out population to 3,320 PE, with an average daily flow of 0.29 MGD.

Table 2-3 | Renaux Manor Potential Annexations

Description	Additional PE	Wastewater (gpd)
Rainbow Hills Subdivision – 52 acres of single-family dwellings totaling 57 homes at a development density of 3.5 PE per home located in the area between Route 64 and Campton Hills Drive.	200	19,950
Lake Charlotte Subdivision – 105 acres of single-family dwellings totaling 138 homes at a development density of 3.5 PE per home located between Route 64 and Campton Hills Road.	483	48,300
Bonnie Drive Subdivision - Twenty-eight acres of single-family dwellings totaling 31 homes at a development density of 3.5 PE per home located north of Route 64 along Bonnie Drive.	109	10,850
4 Lots on Dean Street – Seven acres of single-family dwellings totaling of 4 homes at a development density of 3.5 PE per home located on Dean Street west of Burr Road.	14	1,400
Natural Garden Nursery – Sixty-six acres of land currently containing the Natural Garden Nursery for potential rural residential redevelopment at a projected density of 1.0 unit per acre and 3.5 PE per unit.	230	23,100
4 Lots West of Oakwood Drive – Nine acres currently containing 4 residences for potential rural residential redevelopment at a projected density of 1.0 unit per acre and 3.5 PE per unit located along Route 64 west of Oakwood Drive.	32	3,185
Dean Street Undeveloped Farmland – Twenty-three acres of undeveloped farmland zoned for rural residential use at a projected density of 1.0 unit per acre and 3.5 PE per unit located south of the Dean Street and Burr Road intersection.	80	8,015
Total	**1,148**	**114,800**

Table 2-4 | Renaux Manor Basin Population and Flow Projections

Description	2013 PE	Current Development	Future PE	Build-Out PE
Renaux Manor Service Area	1,758	414	1,148	3,320
Average Daily Flow (MGD)	0.14	.04		**0.29**
***Existing Flows based on 77.70 gpd/ PE **Future Flows Based on IEPA 100 gpd/PE**				

2.4.2 Pine Ridge Drainage Basin

The Pine Ridge Drainage Basin is tributary to the recently constructed Pine Ridge Lift Station located at the intersection of Oak Street and Woodward Drive. This area contains the Regency Estates subdivision and Pine Ridge commercial development. Regency Estates has multiple vacant lots (shown in red) that, if developed, would add approximately 65 PE to the basin.

Exhibit 2-5 | Pine Ridge Drainage Basin

Commercial development (retail or office space) is planned for a large portion of the basin (shown in pink). This commercial development is projected to add approximatly 250 PE. The remaining property within this service area is designated as open space for stormwater drainage or public land use. This equates to a build-out total of 326 PE with a projected average daily flow of 0.03 MGD.

Table 2-5 | Pine Ridge Basin Population and Flow Projections

Description	2013 PE	Current Development	Future PE	Build-Out PE
Pine Ridge Service Area	11	65	250	**326**
Average Daily Flow (MGD)	0.001			**0.03**
***Existing Flows based on 77.70 gpd/ PE **Future Flows Based on IEPA 100 gpd/PE**				

2.4.3 Zylstra Drainage Basin

In 2006, this area was not tributary to the West Side WRF. In 2007, the Zylstra Lift Station was constructed near the intersection of Route 64 and Randall Road to serve the Zylstra Harley Davidson Dealership (Now Fox River Harley Davidson) and future development of the Zylstra property. Upon the completion of the lift station, the existing sanitary sewer serving the nearby Post Office, Amcore Bank and Oak Street Water Filtration Facility was rerouted from the City's Main WWTF Service Area to the Zylstra Lift Station.

Exhibit 2-6 | Zylstra Drainage Basin

Well #13 at the Oak Street Water Filtration Facility backwashes regularly and discharges to the Zylstra drainage basin. This equates to 3.74 million gallons per year or 10,260 gallons per day of wastewater. Based on 77.70 gpd of wastewater per PE it can be estimated that the Oak Street Facility will contribute 132 PE. The Post Office, Amcore Bank and Zylstra Dealership equate to 148 PE for a approximate 2013 basin total of 280 PE. The water billing and projected usages for these properties are detailed in the table below.

Table 2-6 | Zylstra Basin – Water Billing and Wastewater Projections

Description	Water Usage (gpd)	PE	Wastewater (gpd)
Oak St. WTF - Backwash.	10,260	132	10,256
Zylstra Service Area	9,929	148	11,499
Total	**20,189**	**280**	**21,755**

The future development in this basin is limited and no future plans have been presented. The Zylstra property outlots are estimated to contribute an additional 40 PE. The addition of these properties gives a build-out population equivalent of 320 PE.

Table 2-7 | Zylstra Basin Population and Flow Projections

Description	2013 PE	Current Development	Future PE	Build-Out PE
Zylstra Service Area	280	0	40	**320**
Average Daily Flow (MGD)	0.02	0		**0.04**
***Existing Flows based on 77.70 gpd/ PE **Future Flows Based on IEPA 100 gpd/PE**				

2.4.4 Gravity Drainage Basin

The Gravity Drainage Basin is directly tributary to the West Side WRF. This basin encompasses the area west of Randall Road between Campton Hills Drive and Bricher Road to the western limits of the City's corporate boundary. The 2013 water and sewer billing records indicated that this area contains approximately 4,226 PE.

Table 2-8 | Gravity Drainage Basin – Water Billing and Wastewater Projections

Description	Water Usage (gpd)	PE	Wastewater (gpd)
IYC – Wastewater Received.		1,026	79,723
IDOT – Estimated Wastewater Received		13	1,000
Gravity Basin Service Area	214,616	3,187	247,618
Total	**214,616**	**4,226**	**328,341**

The St. Charles Park District recently installed a new water park in the western gravity drainage basin, named Otter Cove Water Park. The new waterpark is a large user for the City, and is one of the largest users on the West Side. Although the water usage is high for this facility, all of the water is not returned to the wastewater treatment plant. Several types of losses are possible, evaporation, over spray, and splashing. During operation, only the backwash water from Otter Cove is sent to the West Side WRF. At the end of each season, the pool is drained and the water is sent down the storm sewer, and does not return to the West Side WRF.

When the City purchased the West Side WRF from the Department of Corrections (DOC), the agreement included a reservation of 180,000 gallons per day, 0.18 MGD, of capacity to address the DOC's needs and prior service commitments. The Illinois Department of Corrections had entered into an intergovernmental agreement with the Kane County Building Commission to provide 58,652 gallons per day of capacity for the Kane County Judicial Center. The Department of Corrections also had an intergovernment agreement with the Illinois Department of Transportation to serve their facility at the intersection of Peck Road and Route 38 with an estimated 1,000 gallons per day of wastewater transmitted. The 180,000 gallons per day

included 59,652 gallons per day reserved for Kane County and IDOT leaving 120,348 gallons of wastewater per day reserved for the Illinois Youth Center. The Illinois Youth Center currently uses 79,723 gallons per day of that capacity. The breakdown of the commitments are summarized in the table below.

Table 2-9 | D.O.C. Wastewater Treatment Capacity Agreement (2013)

Description	Wastewater Committed (gpd)	Wastewater Received (gpd)	Remaining Capacity (gpd)	Remaining Capacity (PE)
Illinois Youth Center	120,348	79,723	40,625	406
Kane County Judicial Center	58,652	11,745	46,907	469
IDOT	1,000	1,000	0	0
Total	**180,000**	**92,468**	**87,532**	**875**

The Kane County Adult Justice Center housing 608 beds has been constructed on the Kane County Judicial Center property which added an IEPA permitted 467 PE or 46,700 gallons per day for a total of 58,445 gallons per day from the Kane County Judicial Center property. As indicated in the table above this exceeds the remaining capacity alloted to the Kane County Judicial Center in their original intergovernmental agreement. An updated breakdown is provided below for the 2013 projection.

Table 2-10 | D.O.C. Wastewater Treatment Capacity Agreement (Projected)

Description	Wastewater Committed (gpd)	Wastewater Received (gpd)	Remaining Capacity (gpd)	Remaining Capacity (PE)
Illinois Youth Center	120,348	79,723	40,625	406
Kane County Judicial Center	58,652	58,445	207	2
IDOT	1,000	1,000	0	0
Total	**180,000**	**139,168**	**40,832**	**408**

The following exhibit and table indicate potential development and redevelopment properties to be served within the Gravity Basin. It is estimated that the identified properites could add 4,194 PE to the service area for a build-out total of 8,420 PE. Based on a future daily usage of 100 gallons per day per PE, it is estimated that these developments could produce an addtional 419,400 gallons of wastewater per day.

Exhibit 2-7 | Gravity Drainage Basin

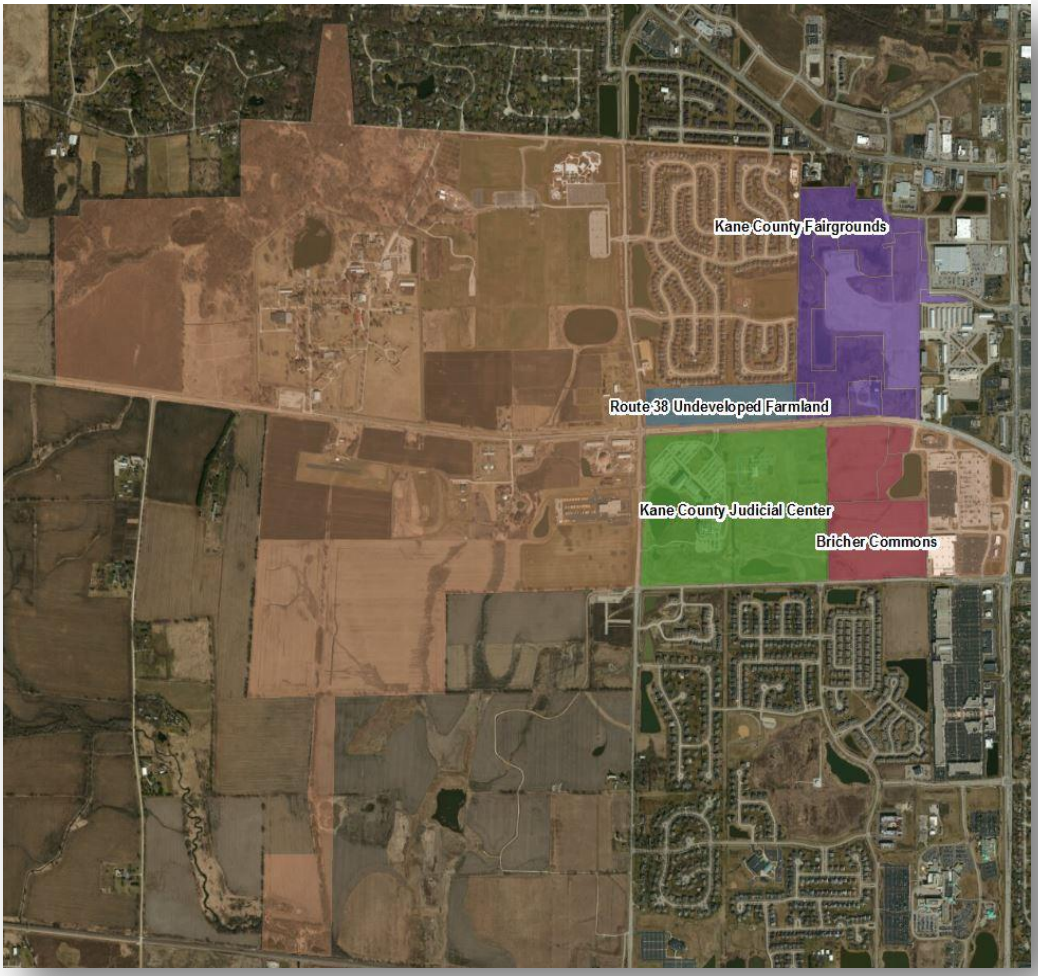


Table 2-11 | Gravity Basin Future Development

Description	Additional PE	Wastewater (gpd)
Kane County Judicial Center – Build-out of the Judicial Center complex will include an additional wing. The additional wing will be three stories of office space.	160	16,000
Route 38 Undeveloped Farmland – Twenty-four acres of undeveloped farmland zoned for public and use at a projected density of 10 PE per acre on the north side of Route 38 across from the Kane County Judicial Center.	243	24,300
Bricher Commons – Proposed mixed use development consisting of 32 acres of residential and 23 acres of commercial development located between Bricher Road and Route 38 west of Randall Road.	2,064	206,400
Kane County Fairgrounds Parking and Open Area – 118 acres currently containing a gravel parking area for the Kane County Fairgrounds and the unincorporated lots of Parent Petroleum and Morelli Legal for potential redevelopment at a development density of 12 PE per acre.	1,202	120,200
Total	**3,669**	**366,900**

Table 2-12 | Potential Facility Planning Area Expansion

Description	Additional PE	Wastewater (gpd)
Undeveloped Farmland – Undeveloped farmland that might be developed into 150 single family units. This area is not within the current Facility Planning Area, but may be added in the future.	525	52,500
Total	**525**	**52,500**

Table 2-13 | Gravity Basin Population and Flow Projections

Description	2013 PE	Current Development	Future PE	Build-Out PE
Gravity Basin Service Area	4,226	0	4,194	**8,420**
Average Daily Flow (MGD)	0.33	0		**0.75**
***Existing Flows based on 77.70 gpd/ PE** ****Future Flows Based on IEPA 100 gpd/PE**				

2.4.5 Summary of Population Projections

The West Side Service Area served 6,275 PE in 2013 and the West Side WRF treated 0.49 MGD of wastewater. Taking into consideration ongoing development, governmental capacity commitments, and potential annexations, the population equivalent of the service area will eventually be increased by 6,111 PE. This equates to a build-out projection of 12,386 PE at an average daily flow (ADDF) of 1,110,000 gal/day or 1.11 MGD.

Table 2-14 | Projected Population and Wastewater Flows

Description	2013 Conditions		Current Development		Build-Out Projection	
	PE	ADDF (MGD)	PE	ADDF (MGD)	PE	ADDF (MGD)
Renaux Manor Basin	1,758	0.14	414	0.04	3,320	0.29
Pine Ridge Basin	11	0.001	65	0.006	326	0.03
Zylstra Basin	280	0.02	0	0.00	320	0.04
Gravity Basin	4,226	0.33	0	0.00	8,420	0.75
Total	**6,275**	**0.49**	**479**	**0.046**	**12,386**	**1.11**
Peaking Factor		3.15		3.98		2.86
Peak Hourly Flow (MGD)		**1.54**		**0.18**		**3.18**

The current West Side WRF has a capacity of 700,000 gallons per day (0.700 MGD). The 2013 wastewater projections for this service area are 487,350 gallons per day. This value includes 40,832 gpd committed for increased flow from the Department of Corrections that the City agreed to when the West Side WRF was purchased. Therefore, the remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. Current development will create an average daily flow of approximately 0.54 MGD, and not require the expansion of the West Side WRF. However, build-out conditions will require expansion. When the average influent approaches 80% of its design flow, or 0.56 MGD, it is recommended that the City begin planning for the expansion of the West Side WRF. This recommendation is further detailed in Section 5 and 6 of this report.

SECTION 3

COLLECTION SYSTEM

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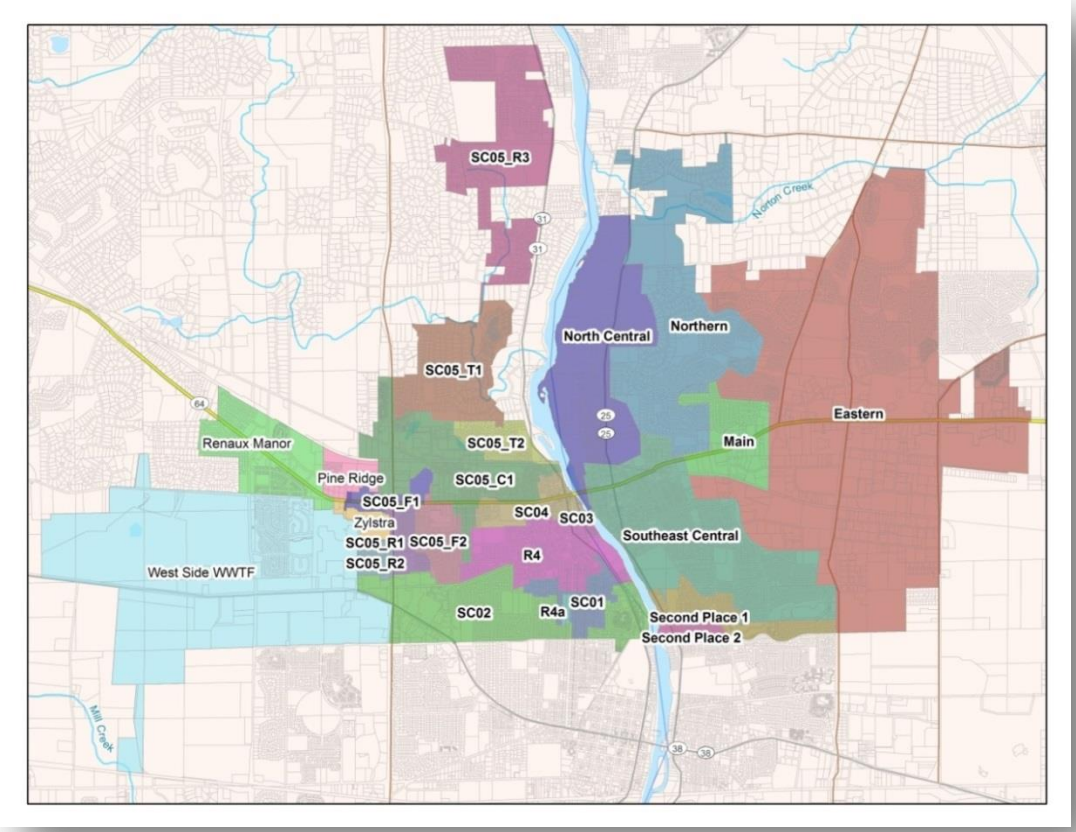
3. COLLECTION SYSTEM

3.1 GENERAL

The City of St. Charles wastewater collection system includes two service areas generally divided by Randall Road. The sanitary sewer system east of Randall Road is tributary to the Main WWTF. The sewers within this collection system are of varying age and condition. As with many older collection systems, infiltration and inflow is a concern. Recognizing the importance of removing infiltration and inflow from the collection system, the City of St. Charles has developed a rigorous maintenance program including flow monitoring, root cutting, grouting, sewer lining and other rehabilitation and replacement of the collection system.

Exhibit 3-1 | Wastewater Drainage Basins

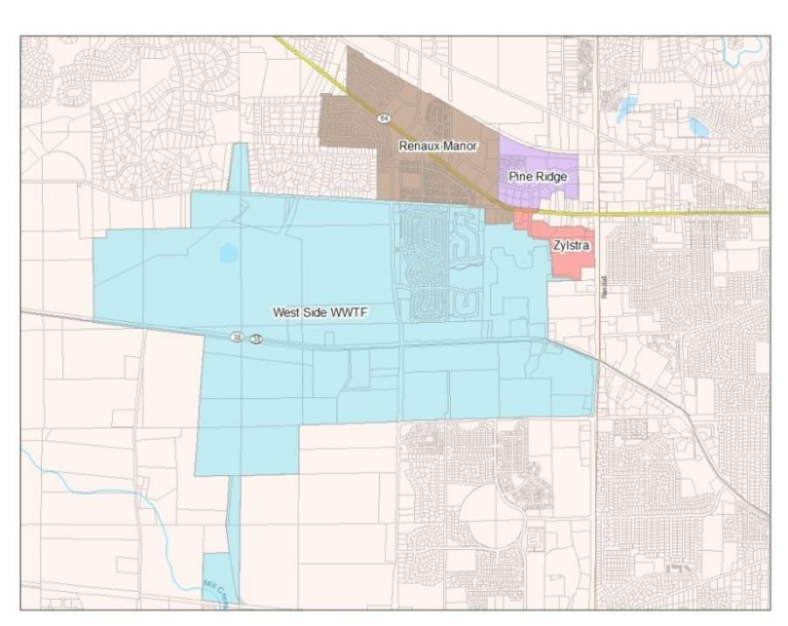


The sanitary sewers west of Randall Road are tributary to the West Side Water Reclamation Facility (WRF). This service area is relatively new and the sewers have been constructed with modern materials, which minimize infiltration and inflow. This Section of the report analyzes the existing West Side WRF collection system characteristics and capacity in detail.

The majority of the existing sanitary sewers within the West Side WRF's collection system are less than fifteen years old. Most of these properties consist of newer residential neighborhoods and commercial developments constructed with PVC sewer pipe. The exception would be the sewers contained within the Illinois Youth Center are maintained by the Department of Corrections. These sewers were originally installed in the 1960's and are generally constructed of clay pipe. The 1998 Facility Plan Amendment identified that the sanitary sewer system which serves the Illinois Youth Center had historically been subject to high infiltration and inflow (I/I) which is often found in older areas that contain clay sewer pipe. As a condition of the purchase agreement for the wastewater treatment facility, the Department of Corrections conducted an evaluation of the existing sanitary sewer system to identify and remove infiltration and inflow sources to the collection system. From this evaluation it was determined that the I/I was limited primarily to direct inflow which was substantially reduced through the improvements made throughout the evaluation.

The collection system within the West Side Service Area has been separated into four major drainage basins. Generally, each major drainage basin is tributary to its own dedicated interceptor sewer or regional lift station. Through analysis of these major drainage basins, the remaining capacities of each basin's interceptor sewers have been determined and are detailed in this Section. The remaining capacity in each pipe can then be monitored to determine if their size must be increased or if additional interceptor sewers are needed to accommodate flow from future development.

Exhibit 3-2 | West Side WRF Service Area Drainage Basins



The City has developed an extensive televising, cleaning and inspection program for the entire collection system. The collection system was divided into four quadrants (NE, SE, NW, and SW). The north/south dividing line is the Fox River that runs through the heart of downtown St. Charles and the east/west dividing line is Route 64. The City has televised, cleaned and inspected three out of the four quadrants to date, and the SW quadrant should be inspected in the near future. This is a continuous program that will repeat upon completion. This will assist the City in identifying problem locations for future projects.

In addition to the inspection and cleaning program, the City has identified that I/I is a large problem. The City has addressed the majority of the locations where spot repairs were needed. As a result of the repairs, the City has reduced a substantial amount of I/I. However, some locations continue to experience I/I. The City recognized that a large portion of I/I is a result of large private entities (schools, businesses and churches) not having the proper inspections during construction and the potential for illegal connections. The City plans on inspecting these locations to continue the reduction of I/I throughout the collection system.

The City of St. Charles' Finance Department actively maintains its GASB 34 Report, however, the collection system is not broken out by treatment facility. Therefore the actual value of this asset for the Main Service Area is not known. It has been estimated that the City currently maintains 157 miles of sanitary sewer mains (gravity and force main), as well as roughly 4,040 sanitary manholes in the Main and West Service Areas.

Using estimated replacement unit costs for sanitary sewer pipes, sanitary manholes and lift stations, the City owns and maintains a $220 million dollar collection system. Assuming 10% contingency and 15% engineering costs, the replacement of the entire collection system is estimated to cost approximately $275 million. However, the majority of the collection system is not in need of replacement. The service life of a collection system is approximately 75 years, and this life can be extended by approximately 25 years with ongoing maintenance and rehabilitation. Based on straight-line depreciation over this 100-year service life, the City should be reinvesting about $2,751,000 annually toward sanitary sewer collection system rehabilitation. Approximately 20% of the collection system is already beyond its initial 75-year service life, and may be considered fully depreciated and in need of replacement. The City should be reinvesting $1,403,000 annually toward the replacement of sewers that were installed before 1941 (as a portion of the annual reinvestment). The remainder of the annual reinvestment should be put towards the CMOM Program. In order to fully fund the long-term viability of the sewer utility, the City's sewer rehabilitation budget should be raised to the aforementioned level if it has not been already. If the money is not used, it should be placed into a replacement account for future use.

This Section will revisit each of the basins, and will conclude with an overview of a CMOM Program for the City's entire collection system.

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3.2 PINE RIDGE DRAINAGE BASIN

The Pine Ridge Drainage Basin is located in the northeast corner of the West Side Service Area and includes nearly 70 acres. This basin contains the Regency Estates Subdivision (currently under construction) and the Pine Ridge commercial development. The development has had minor construction over the past few years, the majority of which was residential homes. Therefore, this drainage basin is currently serving 11 PE. Upon completion of the developments, this basin can be expected to contain 261 PE. The Regency Estates and Pine Ridge developments will be tributary to the Pine Ridge Lift Station. The 4-inch force main from this lift station discharges to a sanitary manhole in the Renaux Manor Drainage Basin.

Exhibit 3-3 | Pine Ridge Basin

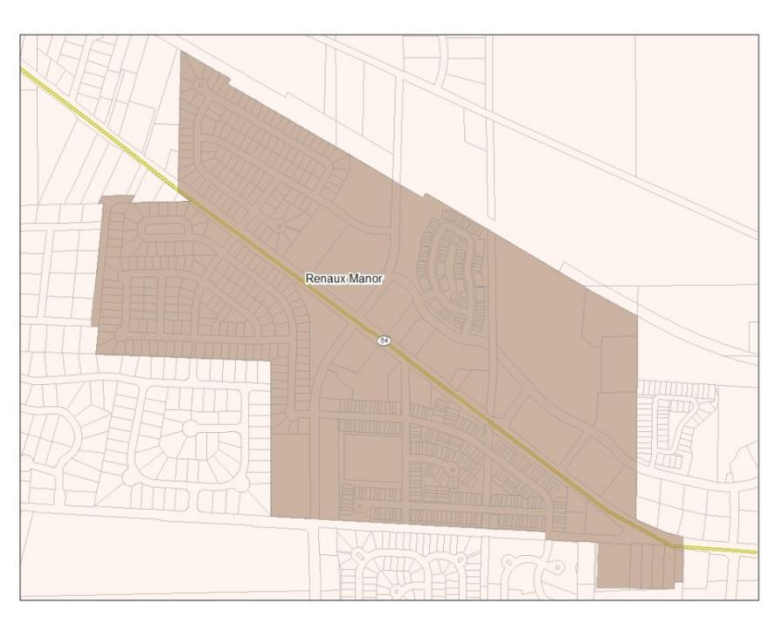
Table 3-1 | Pine Ridge Basin Population and Flow Projections

	PE	ADDF (MGD)	Peaking Factor	PHF (MGD)
Existing Conditions	11	0.001	4.41	0.004
Build-Out Conditions	326	0.03	4.06	0.13

3.3 RENAUX MANOR DRAINAGE BASIN

The Renaux Manor Drainage Basin is located in the northern portion of the West Side Service Area. This basin includes the area north of Campton Hills Drive east of this road's intersection with Route 64. This basin includes nearly 285 acres of residential, commercial and industrial usage currently containing approximately 1,758 PE.

Exhibit 3-4 | Renaux Manor Drainage Basin



The 15-inch diameter Renaux Manor Interceptor Sewer serves the majority of the drainage basin, as well as the 4-inch diameter force main from the Pine Ridge Lift Station. Flow is conveyed from the Renaux Manor Lift Station to a sanitary manhole in the Gravity Drainage Basin.

Table 3-2 | Renaux Manor Basin Population and Flow Projections

	PE	ADDF (MGD)	Peaking Factor	PHF (MGD)
Existing Conditions	1,758	0.14	3.63	0.50
Build-Out Conditions	3,320	0.29	3.40	1.00

Analysis of the existing and build-out capacities of the major interceptor sewers within the Renaux Manor Drainage Basin are shown in the table below. Even under the assumption that both interceptor sewers were constructed at minimum slope (and therefore have minimum conveyance capacity), they are both adequately sized for the build-out of this drainage basin.

Table 3-3 | 8-Inch Pine Ridge Interceptor Sewer – 0.49 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent	11	326
ADDF (MGD)	0.001	0.03
Peaking Factor	4.41	4.06
PHF (MGD)	0.004	0.13
Utilization (Percent)	**1%**	**27%**

Table 3-4 | 15-Inch Renaux Manor Interceptor Sewer – 1.61 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent*	1,628	3,190
ADDF (MGD)	0.12	0.28
Peaking Factor	3.65	3.42
PHF (MGD)	0.44	0.94
Utilization (Percent)	**27%**	**58%**

**Note: St. Michel Lane & Raphael Court were not included in the 15" Renaux Manor interceptor sewer calculations. St. Michel Lane & Raphael Court are served by a separate 8" sanitary sewer*

3.4 ZYLSTRA DRAINAGE BASIN

The Zylstra Drainage Basin consists of nearly 47 acres of commercial and industrial usage located near the southwest corner of the intersection of Route 64 and Randall Road. This basin was created in 2007 and currently serves the Oak Street Water Filtration Facility, US Post Office, First State Bank and Fox River Harley Davidson Property for an estimated total of 148 PE. The basin contains 8-inch diameter sewers that serve the entire basin and discharge directly to the Zylstra Lift Station. Wastewater from this lift station is conveyed through a 4-inch diameter force main to the Gravity Drainage Basin.

Exhibit 3-5 | Zylstra Drainage Basin

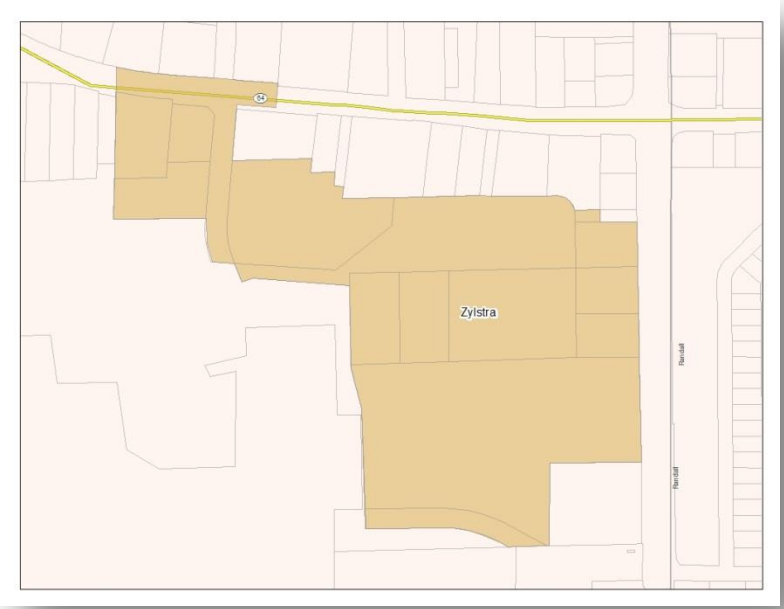


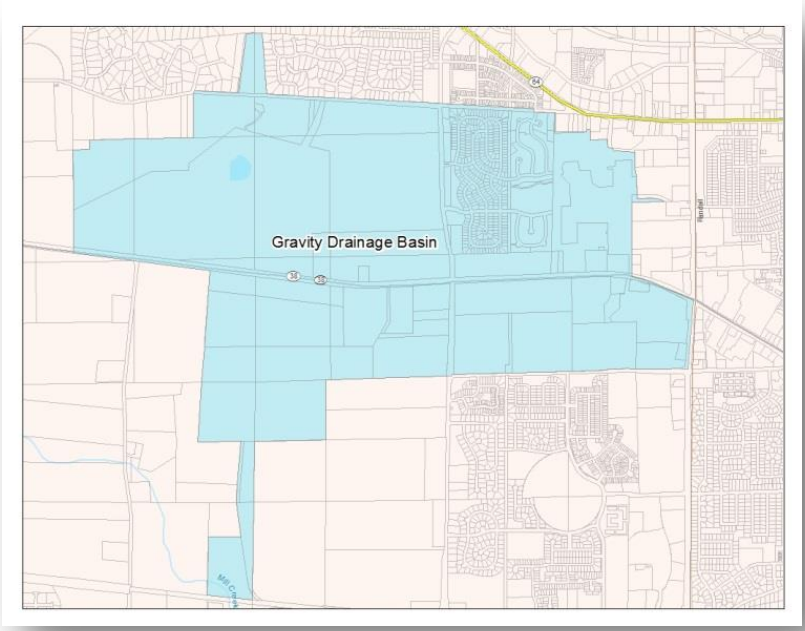
Table 3-5 | Zylstra Basin Population and Flow Projections

	PE	ADDF (MGD)	Peaking Factor	PHF (MGD)
Existing Conditions	280	0.02	4.09	0.09
Build-Out Conditions	320	0.04	4.07	0.16

3.5 GRAVITY DRAINAGE BASIN

The Gravity Drainage Basin includes the majority of the West Side Service Area. The basin is bordered on the east by Randall Road and on the west by the City's corporate boundary. Campton Hills Drive and Bricher Road make up the northern and southern borders of the basin, respectively. The 2013 water and sewer billing records indicated that this area contains approximately 4,226 PE, of which 1,026 PE are contained within the 280-acre Illinois Youth Center property. The Department of Corrections owns and maintains the sanitary sewer within this property, which then discharges into the drainage basin near the raw sewage pump station on the West Side WRF Site. The remaining 3,200 PE within the Gravity Drainage Basin consists of a mixed use of commercial, residential, industrial and governmental areas.

Exhibit 3-6 | Gravity Drainage Basin



Within this basin, a 10-inch interceptor sewer receives flow from the Zylstra Lift Station, and also serves the northern half of the Harvest Hills Subdivisions. This sewer discharges to the 18-inch Peck Road Interceptor Sewer, which also receives flow from the Renaux Manor Lift Station and several properties along Peck Road. The 12-inch Route 38 Interceptor Sewer serves the commercial areas along Randall Road and Route 38 in the southeastern area of the Gravity Drainage Basin. The 18-inch and 12-inch interceptor sewers combine into the 24-inch Main Interceptor Sewer, which discharges directly to the West Side WRF.

Table 3-6 | Gravity Basin Population and Flow Projections

	PE	ADDF (MGD)	Peaking Factor	PHF (MGD)
Existing Conditions	4,226	0.33	3.31	1.09
Build-Out Conditions	8,420	0.75	3.03	2.26

Analysis of the existing and build-out capacities of the major interceptor sewers within the Gravity Drainage Basin are shown in the table below. The capacities shown below are based on minimum slope of the sewer pipe size per EPA standards. If significant additional hydraulic capacity is to be added to the 18" Peck Road or 12" Route 38 Interceptor Sewers, the City should confirm invert elevations and slope to determine if the actual capacities will be exceeded.

Table 3-7 | 10-Inch Zylstra Interceptor Sewer – 0.75 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent*	280	320
ADDF (MGD)	0.02	0.04
Peaking Factor	4.09	4.07
PHF (MGD)	0.09	0.16
Utilization (Percent)	**12%**	**21%**

Table 3-8 | 18-Inch Peck Road Interceptor Sewer – 2.35 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent*	3,435	5,103
ADDF (MGD)	0.267	0.64
Peaking Factor	3.39	3.24
PHF (MGD)	0.91	2.09
Utilization (Percent)	**38%**	**89%**

Table 3-9 | 12-Inch Route 38 Interceptor Sewer – 1.07 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent*	1,538	3,387
ADDF (MGD)	0.120	0.41
Peaking Factor	3.67	3.40
PHF (MGD)	0.44	1.38
Utilization (Percent)	**41%**	**128%**

Table 3-10 | 24-Inch Main Interceptor Sewer – 4.13 MGD Minimum

	Existing Conditions	Build-Out Conditions
Population Equivalent*	6,275	12,385
ADDF (MGD)	0.49	1.10
Peaking Factor	3.15	2.86
PHF (MGD)	1.54	3.14
Utilization (Percent)	**37%**	**76%**

3.6 CAPACITY, MANAGEMENT, OPERATION AND MAINTENANCE (CMOM) PROGRAM

As stated previously, the City has developed an extensive televising, cleaning and inspection program has been implemented for the entire collection system. The City has completed approximately 75% of this program, and will complete the remaining 25% in the near future. The program will then start over with the intention of inspecting the entire system once every 10 years. Most of this work was performed in the Main Service Area due to the much older collection system. For example, the amount of I/I was roughly 26 gallons per day per PE in 2011-2013 for the Main Service Area, and was roughly 6 gallons per day per PE during the same period. However, the City has one Facility Planning Area that encompasses both the Main and West Side Service Areas, and therefore the entire collection system should be incorporated into the City's CMOM program. The discussion of this program and the costs associated with it are included below, and can also be found in Section 3 of the Facility Plan Update for the Main Wastewater Treatment Facility:

The I/I currently accounts for approximately13% of the total influent flow received at the West Side WRF, and approximately 28% of the total influent flow received at the Main WWTF. During particularly severe wet weather events, the City must deploy trash pumps at certain locations in the collection system. These pumps relieve the hydraulic loading on the collection system by discharging raw sewage directly to nearby waterways, namely the Fox River. While these types of bypass pumping activities prevent basement back-ups, they are categorized as Sanitary Sewer Overflows (SSO's) by the IEPA and are prohibited by the City's NPDES Permit. While SSO's are rare, they have occurred in the past and the City is continuously striving to prevent them from happening in the future. Special Condition 21 of the City's renewed NPDES Permit for the Main WWTF outlines the efforts required of the City to eliminate basement back-ups and SSO's.

SPECIAL CONDITION 21. The Permittee shall work towards the goals of achieving no discharges from sanitary sewer overflows or basement backups and ensuring that overflows or backups, when they do occur do not cause or contribute to violations of applicable standards or cause impairment in any adjacent receiving water. In order to accomplish these goals, the Permittee shall develop, implement and submit to the IEPA a Capacity, Management, Operations, and Maintenance (CMOM) plan within twelve (12) months of the effective date of this Permit. 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 of the collection system owned and operated by the Permittee;

2. Schedules, checklists, and mechanisms to ensure that preventative maintenance is performed on equipment owned and operated by the Permittee;

3. An assessment of the capacity of the collection and treatment system owned and operated by the Permittee at critical junctions and immediately upstream of locations where overflows and backups occur or are likely to occur; and
4. Identification and prioritization of structural deficiencies in the system owned and operated by the Permittee.

b. Design and Performance Provisions:
1. Monitor the effectiveness of CMOM;
2. Upgrade the elements of the CMOM plan as necessary; and
3. Maintain summary of CMOM activities.

c. Overflow Response Plan:
1. Know where overflows within the facilities owned and operated by the Permittee occur;
2. Respond to each overflow 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.

e. Reporting and Monitoring Requirements.

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.

In response to this Special Condition, the City will need to budget for the preparation and implementation of a CMOM program. It should be noted that GIS data is critical when evaluating the asset value of the collection system. The City's data was reviewed, and it was determined that several miles of sanitary sewers were dated incorrectly. Using historical aerial photography, these sewers were properly categorized as pre- or post-1941 to determine the recommended annual reinvestment for sanitary sewer replacement. We estimate that the City should be reinvesting $2,751,000 annually toward sanitary sewer collection system rehabilitation, and that $1,403,000 be put towards the replacement of sewers that were installed before 1941. The remaining $1,348,000 should be put towards the annual costs of the CMOM program. There are several initial costs involved with starting up a program of this magnitude, which are shown to be included in the 2015/2016 fiscal year budget. This initial cost is estimated to be roughly $550,000. A recommended breakdown of necessary budget items is included on the following page.

Capacity Maintenance, Operation and Management (CMOM)

- *A. Capacity Maintenance and Operation (70% of Budget)*
  - *1. Sanitary Sewer Evaluation Survey (SSES) and Rehabilitation Program*
    - *a) Interceptor Sewer Cleaning and Inspection Project*
      - *(1) STC Staff – $20,000 – FY 2015/2016*
      - *(2) Engineering – $20,000 – FY 2015/2016*
      - *(3) Construction – $360,000 – FY 2015/2016*
    - *b) Interceptor Sewer Capacity Management Program*
      - *(1) STC Staff – $12,000 Annually*
      - *(2) Engineering – ($25,000) Annually*
      - *(3) Construction – ($180,000) Annually*
    - *c) Sanitary Sewer Inspection Program*
      - *(1) STC Staff – $131,000 Annually*
    - *d) Sanitary Sewer Spot Repair Program*
      - *(1) STC Staff – $13,000 Annually*
      - *(2) Engineering – ($28,000) Annually*
      - *(3) Construction – ($166,000) Annually*
    - *e) Sanitary Sewer Lining Program*
      - *(1) STC Staff – $16,000 Annually*
      - *(2) Engineering – ($33,000) Annually*
      - *(3) Construction – ($340,000) Annually*
- *B. Capacity Management (20% of Budget)*
  - *1. Flow Metering Project*
    - *a) Flow Metering Program Development*
      - *(1) STC Staff – $10,000 – FY 2015/2016*
      - *(2) Engineering – $10,000 – FY 2015/2016*
      - *(3) Meter Purchase – $60,000 – FY 2015/2016*
    - *b) Annual Metering Program*
      - *(1) STC Staff – $120,000*
      - *(2) Engineering – $20,000*
  - *2. Sanitary Sewer Modeling/ Atlas Program*
    - *a) Program Development*
      - *(1) STC Staff – $8,000 – FY 2015/2016*
      - *(2) Engineering – $20,000 – FY 2015/2016*
    - *b) Annual Modeling Program*
      - *(1) STC Staff – $10,000*
      - *(2) Engineering – $120,000*
- *C. Private Service Lateral Rehabilitation Program (10% of Budget)*
  - *1. Policy Initiation*
    - *a) Public Education*
      - *(1) STC Staff – $11,000 – FY 2015/2016*
      - *(2) Outside Consultants – $25,000 – FY 2015/2016*
  - *2. Program Implementation*
    - *a) Annual Inspection Program*
      - *(1) STC Staff – $90,000*
    - *b) Annual Lateral Rehabilitation Program*
      - *(1) STC Staff – $18,000*
      - *(2) Construction – $0 – i.e. All homes sold to be inspected and repaired if necessary, paid for by seller*

SECTION 4

LIFT STATIONS

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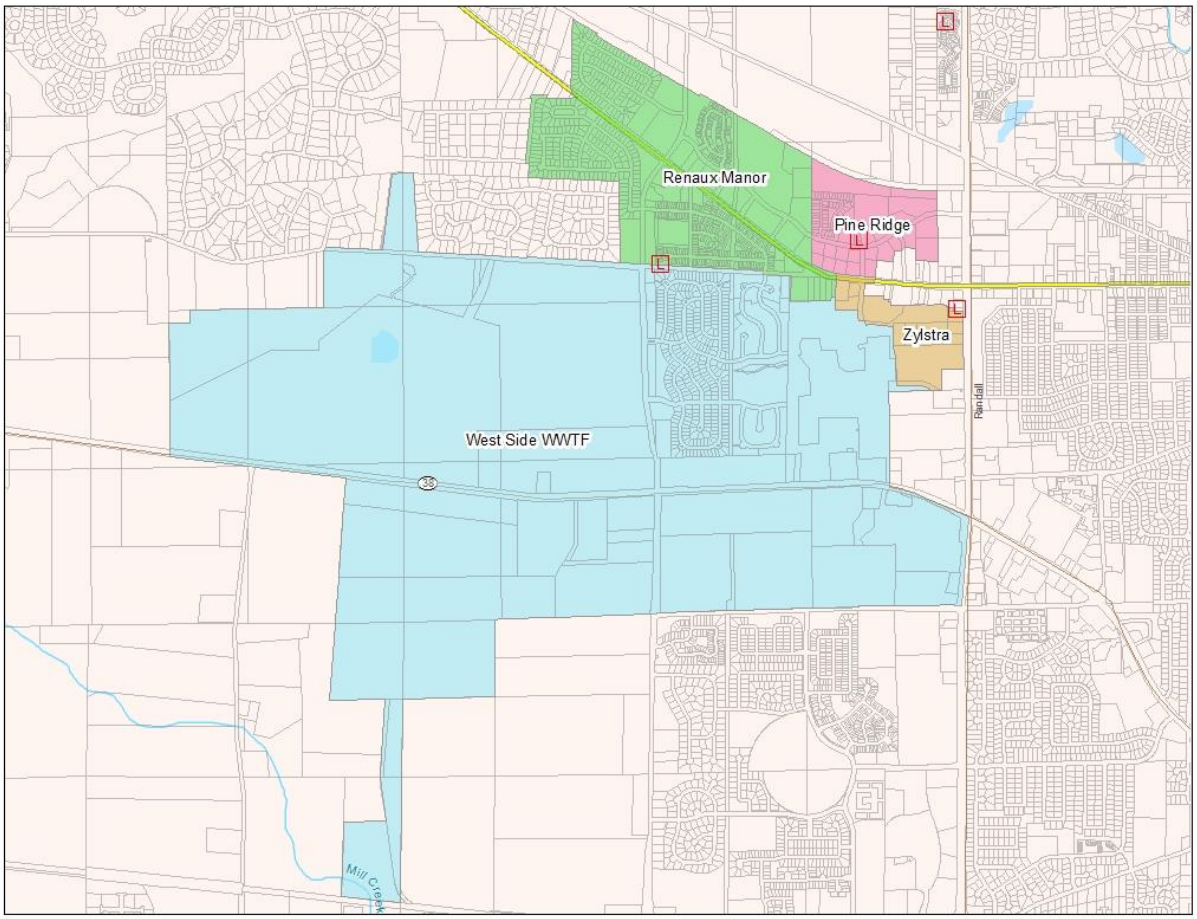
4. LIFT STATIONS

4.1 GENERAL BACKGROUND

The City of St. Charles operates and maintains three lift stations within the West Side Service Area. These installations are reasonably new and have been constructed as the City has grown over the past 15 years. The locations of these lift stations are indicated in the map below.

Exhibit 4-1 | West Side Service Area Lift Stations



The lift stations vary in age and capacity, but were all constructed after 1998 as the City developed further west. The City's staff has assisted in the development of this portion of the Facility Plan Update and has provided input with respect to improvements needed at each station.

Table 4-1 | Lift Station Asset Value

Lift Station	Equipment	Structure	Force Main	Totals
Pine Ridge	$210,000	$185,000	$110,000	$505,000
Renaux Manor	$250,000	$215,000	$382,000	$847,000
Zylstra	$210,000	$185,000	$409,000	$804,000
Totals	$670,000	$585,000	$901,000	$2,156,000
Design Life, Years	20	50	50	
Annual Replacement	$33,500	$11,700	$18,020	**$63,220**

It should be noted that the above figures do not include the engineering and contingencies that would be involved in a rehabilitation or replacement project. The value of the City's lift station and force main assets is approximately $2,160,000. Based on a straight-line depreciation over the design life of the equipment, structures and force mains, the City should be reinvesting around $65,000 annually toward maintaining and replacing these assets within the West Side Service Area.

This section will discuss each lift station's strengths, deficiencies, and future needs independently. Operational staff has indicated that most of the recommended improvements could be accomplished utilizing in-house resources.

4.1 PINE RIDGE LIFT STATION

4.1.1 General Description

The Pine Ridge Lift Station is located at the intersection of Oak Street and Woodward Drive. This lift station was constructed in 2007 to serve the Pine Ridge Park commercial development and Regency Estates residential subdivision. This lift station is currently serving 11 PE, but is projected to serve 326 PE.

This lift station employs a submersible duplex pumping system that discharges through a 906 lineal foot, 4-inch diameter force main. This force main conveys wastewater south to Route 64 and east along Campton Hills Drive until it discharges to a sanitary manhole in the Renaux Manor Drainage Basin located near the northwest corner of Campton Hills Drive and Renard Lane.

Table 4-2 | Pine Ridge Lift Station – Pump and Force Main Data

Number of Pumps	Pump Manuf. & Type	Pump Motor (HP)	Pump Rated Capacity (GPM)	Force Main Dia. (inch)	Rated TDH (feet)	Installation Date
2	Hydromatic Submersible	15	160	4	61	2007

4.1.2 Strengths and Deficiencies

Pine Ridge is in great working condition, as it is relatively new. The pumps, control panel, and generator are all in good shape. The station has bypass capabilities in the valve vault. A significant amount of development can be facilitated in the sanitary basin served by this station as it was designed for larger flows. The collection system tributary to this lift station is relatively new, and does not have significant inflow and infiltration.

Table 4-3 | Pine Ridge Lift Station – Strengths and Deficiecies

Category	Strength	Deficiency
Operations	• Pumps are in good condition • Bypass capabilities	
Maintenance	• No issues noted	
Aesthetics	• Hidden by vegetation	
Mechanical & Electrical	• On-site generator	
Miscellaneous		• Not connected to SCADA

4.1.3 Pump Performance

No drawdown test was conducted at the Pine Ridge Lift Station due to low influent flow.

4.2 RENAUX MANOR LIFT STATION

4.2.1 General Description

The Renaux Manor Lift Station is located along the north side of Campton Hills Road, east of the Peck Road intersection. This lift station was constructed in 1998 and serves the Renaux Manor Drainage Basin. This basin includes 285 acres of mixed residential and commercial use currently containing 1,758 PE. Additionally, the Pine Ridge Lift Station discharges into the Renaux Manor Drainage Basin. Tributary flow from the Pine Ridge lift station will ultimately add 326 PE to the Renaux Manor Lift Station loading for a total of 2,084 PE. Considering this and future development within Renaux Manor drainage basin, this lift station is projected to serve approximately 3,646 PE.

This lift station utilizes a submersible triplex pumping system that discharges through a 1,470 lineal foot, 12-inch diameter force main. This force main conveys wastewater south along Peck Road until it discharges to a sanitary manhole at the northeast corner of the intersection of Peck Road and Springfield Way.

Table 4-4 | Renaux Manor Lift Station – Pump and Force Main Data

Number of Pumps	Pump Manuf. & Type	Pump Motor (HP)	Pump Rated Capacity (GPM)	Force Main Dia. (inch)	Rated TDH (feet)	Installation Date	Rehab Date
3	Hydromatic Submersible	7.5	690	12	29	1998	2013

4.2.2 Strengths and Deficiencies

One of the three pumps in this lift station is in need of replacement. There is a bypass connection located above the ground next to the valve vault. A lock is missing from one of the access hatches and should be replaced. The pumps used to run off of variable frequency drives, but after several power outages that were determined to be a result of these drives, they have been decommissioned. The lift station should be connected to the City's SCADA with any rehabilitation.

Table 4-5 | Renaux Manor Lift Station – Strengths and Deficiencies

Category	Strength	Deficiency
Operations	• Bypass capability	• Middle pump is not operational
Maintenance	• No issues noted	
Aesthetics	• Significant distance between station and roadway, hidden by vegetation	• Lock missing on access hatch
Mechanical & Electrical	• On-site generator	
Miscellaneous		• Decommissioned VFDs • Not connected to SCADA

4.2.3 Pump Performance

The drawdown test was conducted on June 24, 2014. At the time of this test, only Pumps 1 and 3 were operational. These tests produced suspect results, and another series of tests were conducted on June 10, 2015. At the time of the second test, only Pump 1 was operational. Based on the test results, this pump appears to be adequately sized for the tributary flow, and is within the +/- 8% variance allowed by the Hydraulic Institute. It is recommended that the other two pumps be inspected, rehabilitated or replaced with the maintenance budget.

Table 4-6 | Renaux Manor Lift Station – Pump Drawdown Test Results

Pump	Rated Capacity	Test Flow Rate (gpm)	Tolerance
No. 1	690 gpm @ 29' TDH	723	5%

4.3 ZYLSTRA LIFT STATION

4.3.1 General Description

The Zylstra Lift Station is located at the northeast corner of the Fox River (formerly Zylstra) Harley Davidson property located on Randall Road just south of Route 64. This lift station was completed in 2007 as a part of the Fox River Harley Davidson development to serve the Zylstra Drainage Basin. This basin consists of 47 acres of commercial and governmental use, and is projected to serve 320 PE.

The 4-inch force main discharges to a sanitary manhole located east of the intersection of Tower Hill Drive and Pleasant Plaines Drive in the Gravity Drainage Basin.

Table 4-7 | Zylstra Lift Station – Pump and Force Main Data

Number of Pumps	Pump Manuf. & Type	Pump Motor (HP)	Pump Rated Capacity (GPM)	Force Main Dia. (inch)	Rated TDH (feet)	Installation Date
2	Hydromatic Submersible	15	150	4	87.6	2007

4.3.2 Strengths and Deficiencies

The Zylstra Lift Station is currently operating one pump, as the second pump is inoperable and in need of replacement. The control panel is in good condition. The on-site generator allows the station to operate when there is a power outage. The bypass connection is located just inside the access hatch to the valve vault. The collection system tributary to this lift station is relatively new, and does not have significant inflow and infiltration. The lift station should be connected to the City's SCADA with any rehabilitation.

Table 4-8 | Zylstra Lift Station – Strengths and Deficiencies

Category	Strength	Deficiency
Operations	• Bypass connection close to ground level	• Only one pump operational
Maintenance		
Aesthetics	• Fenced off on a side street	
Mechanical & Electrical	• On-site generator	
Miscellaneous		• Not connected to SCADA

4.3.3 Pump Performance

The drawdown test was conducted on June 25, 2014. Two trials were conducted using the one operational pump. Based on the test results, the pumps appear to be adequately sized for the tributary flow. However, the tested flow rate is outside of the +/- 8% variance allowed by the Hydraulic Institute. It is recommended that the discharge force main be fitted with pressure gages to ensure that the pumps are operating within safe operating range of the manufacturer's pump curve.

Table 4-9 | Zylstra Lift Station Pump Drawdown Test Results

Pump	Rated Capacity	Test Flow Rate (gpm)	Tolerance
No. 1	150 gpm @ 87.6 ' TDH	111	-26%

SECTION 5

EXISTING WEST SIDE WATER RECLAMATION FACILITY

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5. EXISTING WEST SIDE WRF

5.1. GENERAL BACKGROUND AND EXPANSION HISTORY

In 1989, the City of St. Charles was approached by property owners west of Randall Road requesting annexation and sanitary sewer service. In response, the City investigated several alternatives including the acquisition of the Department of Corrections wastewater treatment facility, which served the Illinois Youth Center and the Illinois Department of Transportation's garage. The treatment facility included a 0.35 MGD package treatment plant, polishing pond and sludge drying beds. Effluent from the facility was discharged to Mill Creek near Keslinger Road.

The City submitted a Facility Plan Amendment and request for Facility Planning Area Boundary change in late 1989 and an update in 1991. The boundary change and plan were approved by NIPC and Illinois EPA. The City commenced with Phase I in 1992, which included purchase of the treatment facility and upgrading the facility to meet NPDES standards. Phase I was completed in 1997.

The City updated the Facility Plan again in 1998. The update outlined a phased approach for expansion of the treatment facility, which expanded the plant's capacity in three 0.35 MGD increments. The Illinois EPA approved Phases II and III as recommended with the Facility Plan, which would increase the treatment facility's capacity to 1.05 MGD. However, the Illinois EPA requested that a Facility Plan Update be submitted prior to expansion of the plant to 1.4 MGD to verify capacity requirements. The Illinois EPA issued an NPDES Permit consistent with the recommendations allowing for the Phase II expansion to 0.70 MGD and Phase III expansion to 1.05 MGD.

Once the Facility Plan was approved, the City of St. Charles proceeded with design and construction of the Phase II Improvements. The project was completed in 2001 and funded through the Illinois EPA Revolving Loan Program.

The City updated the Facility Plan again in 2008. This update incorporated phased approach for expansion of the treatment facility as well as an analysis of recently promulgated and pending environmental regulations. The regulatory issues included nutrient removal, suspended solids effluent requirements and bio-solids stabilization, as well as anti-degradation requirements and copper and radium concentrations in the effluent.

Section 2 provides an update of existing, proposed and future development that will be served by the West Side WRF. Section 3 provides a review of the collection system and Section 4 provides an analysis of the existing lift stations. This section is intended to address the existing facility's performance, capacity and needs.

5.2. NPDES PERMIT LIMITS:

The following information is derived from the existing NPDES permit for the City of St. Charles West Side WRF. This permit was effective on June 7th, 2012 and expires on May 31st, 2017.

Flow	
Design Average Flow, MGD	0.70
Design Maximum Flow, MGD	1.75
$CBOD_5$	
Monthly Average, mg/L	10
Monthly Average, lbs.	58
Daily Maximum, mg/L	20
Daily Maximum, lbs.	117
Suspended Solids	
Monthly Average, mg/L	12
Monthly Average, lbs.	70
Daily Maximum, mg/L	24
Daily Maximum, lbs.	140
Fecal Coliform	
Monthly Maximum (May-Oct. Geometric Mean)	200 per 100 ml
pH	
Range	6 - 9
Chlorine Residual	
Daily Maximum, mg/L	0.05

Ammonia Nitrogen

March

Monthly Average, mg/L	1.5
Monthly Average, lbs.	8.8
Weekly Average, mg/L	3.8
Weekly Average, lbs.	22
Daily Maximum, mg/L	4.9
Daily Maximum, lbs.	29

April through October

Monthly Average, mg/L	1.2
Monthly Average, lbs.	7
Daily Maximum, mg/L	3.0
Daily Maximum, lbs.	18

November through February

Monthly Average, mg/L	2.5
Monthly Average, lbs.	15
Daily Maximum, mg/L	6.6
Daily Maximum, lbs.	39

Dissolved Oxygen

March through July

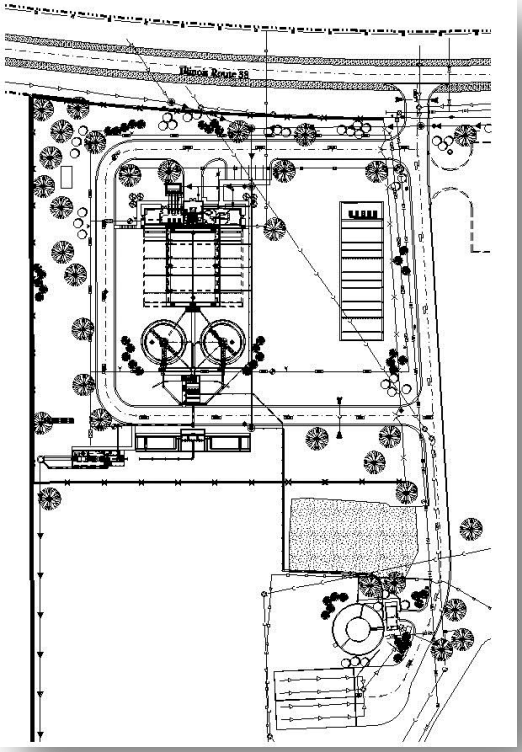
Weekly Average (not less than), mg/L	6
Daily Minimum, mg/L	5

August through February

Monthly Average (not less than), mg/L	5.5
Weekly Average (not less than), mg/L	4
Daily Minimum, mg/L	3.5

5.3. PROCESS SUMMARY

Raw wastewater contains a variety of contaminants including nutrients, organic, and inorganic material that must be removed prior to discharging to a receiving stream. The raw wastewater is transported from the institutions, businesses and residences to the facility through a 24-inch interceptor sewer along Illinois Route 38. The wastewater is received by an influent pump station and conveyed to the headworks where inorganic material such a plastics and rags are screened from the wastewater.



The screened wastewater is then blended with return activated sludge (RAS), which contains beneficial micro-organisms. The resulting thinner sludge is commonly referred to as mixed liquor suspended solids (MLSS). The MLSS is then introduced to the biological process.

The West Side WRF utilizes a biological process known as extended aeration. Extended aeration uses aerobic micro-organisms for the conversion of contaminants including dissolved organic material and ammonia nitrogen. The micro-organisms or bio-mass utilize dissolved oxygen for respiration, which is supplied by compressed ambient air. Within the biological process, the total volume of bio-mass increases as it consumes the contaminants.

Following the biological process, solids are separated from the water through settling in tertiary clarifiers. Most of the settled solids are returned to the beginning of the biological process in the form of return activated sludge or RAS. A portion of the sludge must be wasted to maintain a proper balance. This waste activated sludge (WAS) is transferred to an aerobic digestion process for further stabilization prior to ultimate disposal. The clear water flows over the weirs of the clarifiers to a disinfection process.

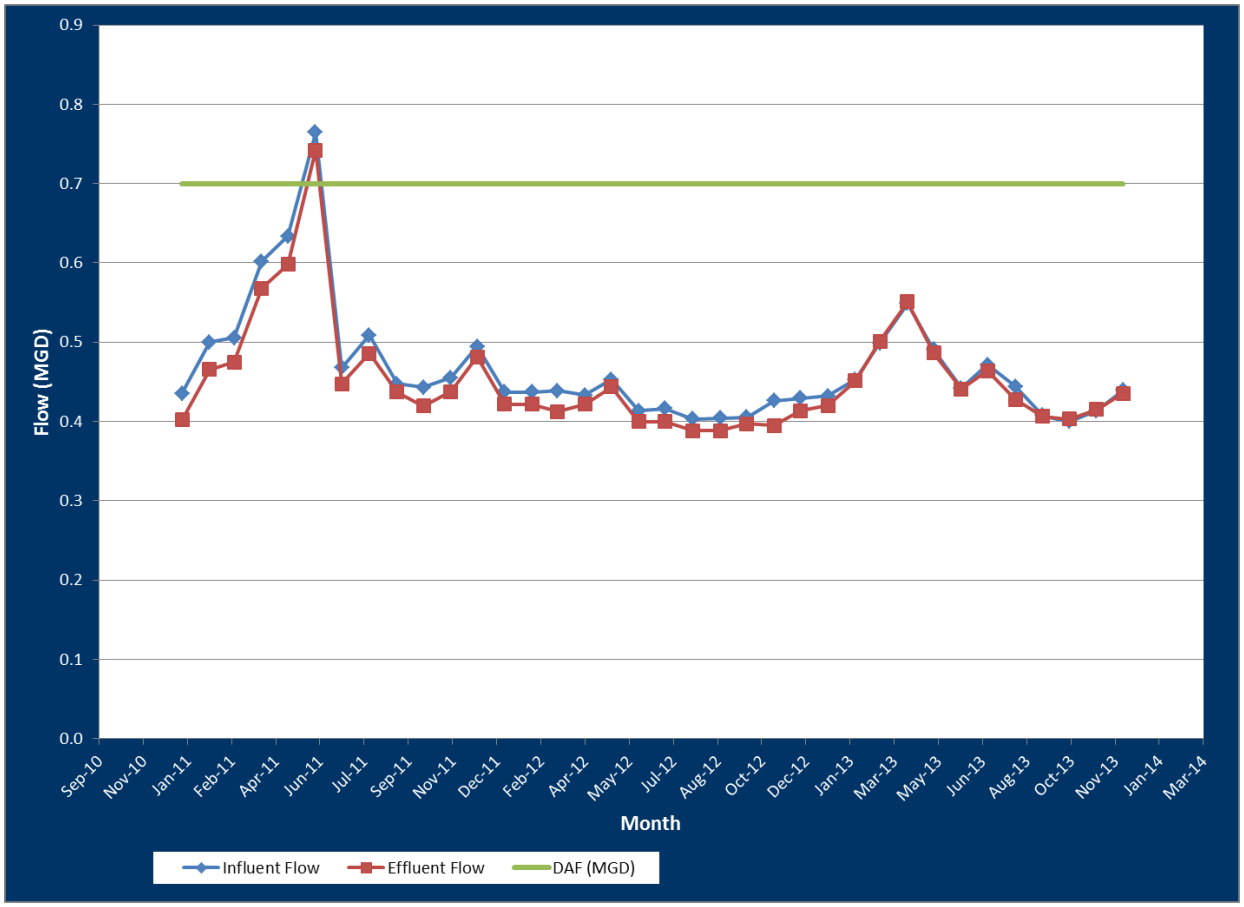
The West Side WRF disinfects the effluent with ultra violet radiation. The U.V. light disrupts the remaining organisms' ability to reproduce or accomplish cell division. The effluent is then conveyed through an outfall sewer to Mill Creek where it is discharged.

5.4. PLANT PERFORMANCE

5.4.1. Influent Flow

The Design Average Flow for the West Side WRF is 0.70 MGD. The Illinois EPA reviews the three low flows months for any twelve-month period. The average of the three low flow months is compared to the design average flow to determine the remaining capacity for connecting additional load and sewer extensions. Below is a chart showing the Design Average Flow and the monthly average flow from 2011 through 2013. Based on the consistency of the flow, it is evident that the collection system is not subject to excessive infiltration and inflow.

Figure 5-1 | West Side WRF – Influent and Effluent Flows



The monthly average flow from 2011 through 2013 ranged from 0.40 MGD up to 0.76 MGD. The table below shows the annual average flow and three low flow months for calendar years 2011 through 2013.

Table 5-1 | West Side WRF – Average and Low Flow Data

	Annual Average Daily Flow	Three Low Flow Months	Three Low Flow Months Average
2011	0.521 MGD	January, October & September	0.442 MGD
2012	0.425 MGD	August, September & October	0.404 MGD
2013	0.453 MGD	October, September & November	0.407MGD

As discussed in Section 2, the property within the West Side Service Area continues to be developed. The West Side WRF has a capacity of 700,000 gallons per day (0.700 MGD). Taking into account metered influent from 2011 and 2013, the West Side WRF treated an average flow of 487,350 gallons per day or 0.487 MGD. This value includes 40,832 gpd committed for increased flow from the Department of Corrections that the City agreed to when the West Side WRF was purchased. This agreement contained projected flow from the Illinois Youth Center, Kane County Judicial Center and the IDOT Facility at Peck Road and Route 38. Therefore, the remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. In addition, Section 2 provides an estimate of 1.11 MGD for Build-out conditions of the service area.

Table 5-2 | West Side Service Area Summary

Description	2013 PE	Build-Out
Renaux Manor Basin	1,758	3,320
Pine Ridge Basin	11	326
Zylstra Basin	280	320
Gravity Basin	4,226	8,420
Total	**6,275**	**12,386**
Average Daily Flow (MGD)	**0.49**	**1.11**

However, the Illinois EPA's method of reviewing the three low-flow months, the average daily flow in 2013 was only 0.453 MGD. Therefore, the remaining capacity from a regulatory perspective is 293,000 gallons per day or 3,980 PE, which equates to 42% of the existing facility's design capacity.

5.4.2. Influent and Effluent $CBOD_5$

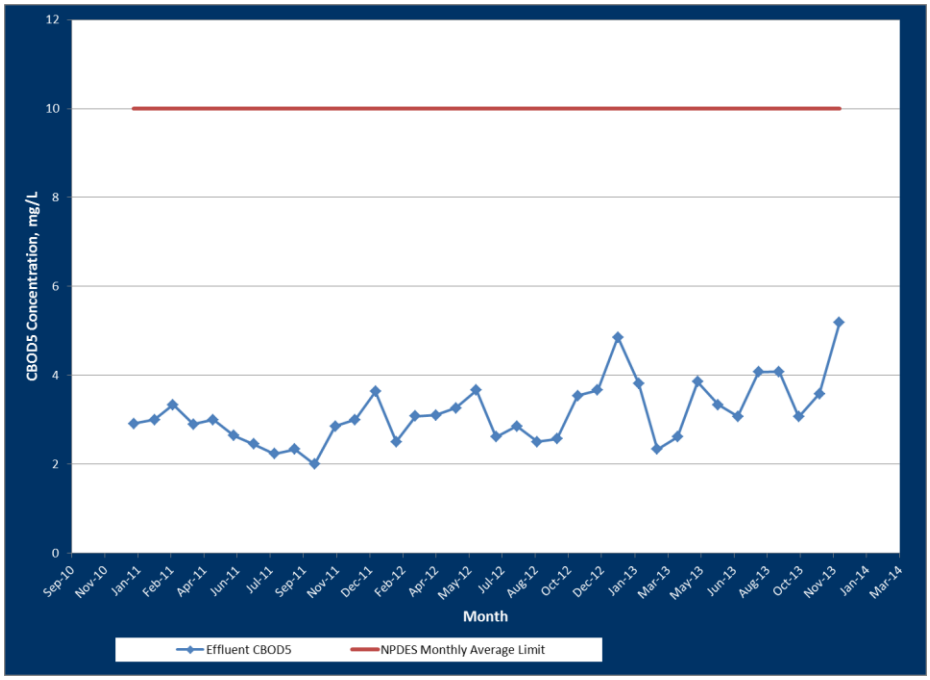
In determining the proper $CBOD_5$ design loading, we reviewed the monthly average, the average monthly maximum and the highest annual maximum for the three-year period. The average monthly maximum is the average of the highest concentration received in each month, while the highest annual maximum represents the highest concentration within the twelve-month period.

Year	*Monthly Average*	*Average Monthly Maximum*	*Highest Annual Max.*
2011	194 mg/L	347 mg/L	1,110 mg/L
2012	231 mg/L	345 mg/L	2,010 mg/L
2013	212 mg/L	340 mg/L	1,200 mg/L
Average	212 mg/L	344 mg/L	1,440 mg/L

The facility should be designed with adequate biological reduction capacity to meet the effluent limits on a continuous basis. The influent concentrations should be evaluated based on 2011, 2012 and 2013 data. The original design was based around the Illinois EPA design standard of 0.17 lbs/ PE/ day or 204 mg/L. This is consistent with the current monthly average. While this design parameter is adequate to determine basin sizing, it is recommended that the aeration system capacity be able to treat the 344 mg/L average monthly maximum.

The Daily Monitoring Reports were reviewed to document the efficiency of the existing process. The average influent and effluent $CBOD_5$ for the period were 212 mg/L and 3.15 mg/L, respectively. This reflects an efficiency of 98.5%.

Figure 5-2 | West Side WRF – $CBOD_5$ Performance



5.4.3. Total Suspended Solids Concentration

Total Suspended Solids (TSS) loadings was were analyzed by comparing the monthly average, the average monthly maximum, and the highest annual maximum for the last three years DMR's.

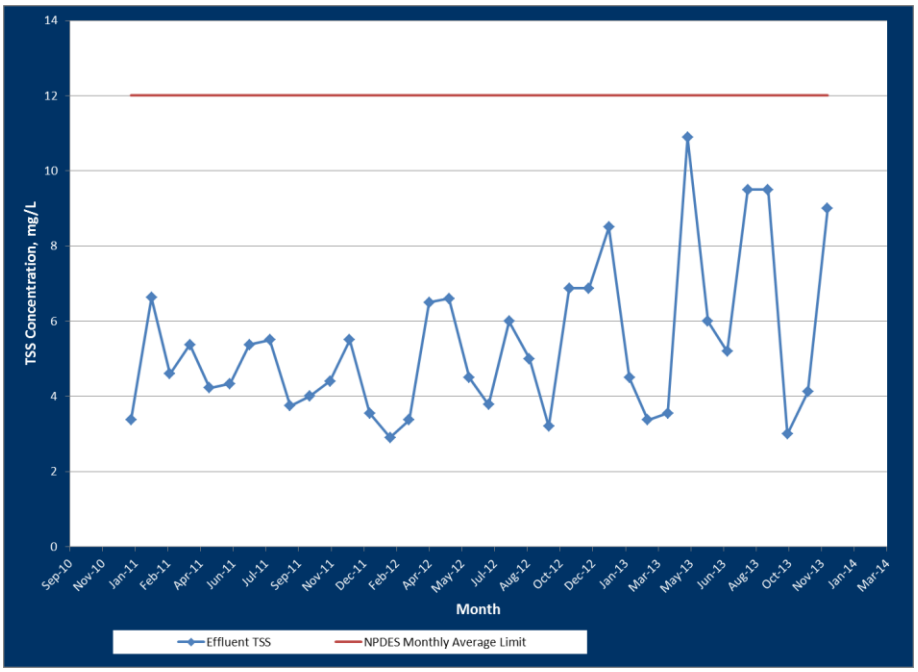
Year	*Monthly Average*	*Average Monthly Maximum*	*Highest Annual Max.*
2011	308 mg/L	639 mg/L	2,750 mg/L
2012	310 mg/L	737 mg/L	3,370 mg/L
2013	265 mg/L	540 mg/L	2,720 mg/L
Average	294 mg/L	638 mg/L	2,947 mg/L

The facility should be designed with adequate solids handling capacity to meet the bio-solids reduction needs on a continuous basis. However, solids reduction is a continuous process in excess of 24 days detention time. Therefore it is not adversely effected by increased solids loading from a single day. The City staff agreed that using the Illinois EPA value of 0.22 lbs./PE/Day or 264 mg/L would provide a conservative design.

TSS = 7,000 PE x 0.22 lbs./PE/day = 1,540 lb./day

The NPDES Permit Limit for TSS is 12 mg/L monthly average and 24 mg/L daily maximum. A similar analysis of the DMR's was completed for this limit. The plant's overall performance from 2011 through 2013 was 98.2% effective with an average effluent concentration of 5.37 mg/L. The plant has been able to meet its permit limits on a continuous basis over the past three years.

Figure 5-3 | West Side WRF – TSS Performance



5.4.4. Ammonia Concentration

Influent Ammonia should be considered similar to BOD5 loading to the biological process by comparing the monthly average, the average monthly maximum and the highest annual maximum for the last three years DMR's.

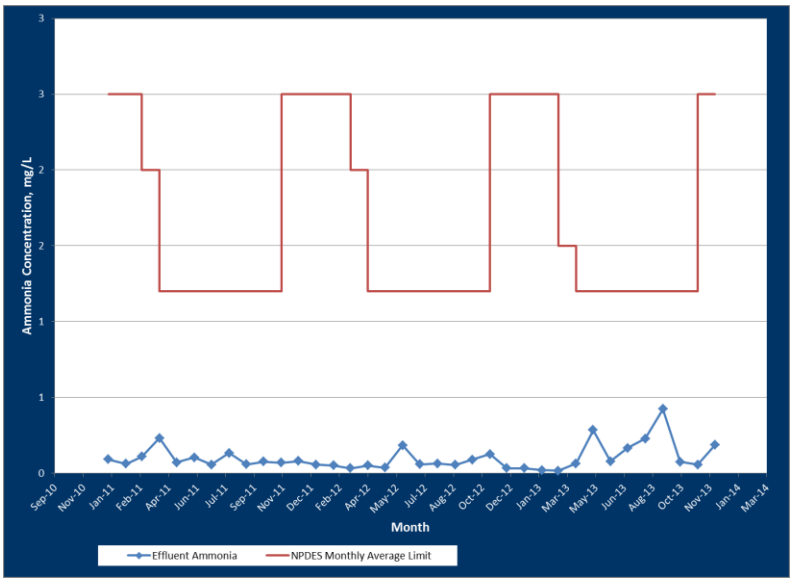
Year	*Monthly Average*	*Average Monthly Maximum*	*Highest Annual Max.*
2011	17 mg/L	21 mg/L	32 mg/L
2012	20 mg/L	23 mg/L	35 mg/L
2013	21 mg/L	27 mg/L	30 mg/L
Average	19 mg/L	24 mg/L	32 mg/L

The facility should be designed with adequate nutrient removal capacity to meet the effluent limits needs on a continuous basis. However, designing around the highest monthly max for each year seems too conservative. Therefore, it is recommended that the design is based around the Average Monthly Maximum.

NH_3-N = 0.7 MGD x 24 mg/L x 8.34 lb./gal. = 140 lb./day

The previous NPDES Permit included stringent ammonia nitrogen effluent limits. A recent decision from the Illinois Pollution Control Board, the permit was revised and permit limits include three seasons: winter, spring/fall, and summer. The current permit was effective in 2012, and incorporated a lower limit for March of 1.5 mg/L. The effluent ammonia concentrations were compared to the current and proposed monthly effluent limits. The plant's overall efficiency from 2011 through 2013 was 99.5% effective with an average effluent concentration of 0.10 mg/L. The plant has been able to meet its permit limits on a continuous basis over the past three years.

Figure 5-4 | West Side WRF – Ammonia Performance



5.5. PHASE II – ORIGINAL DESIGN PARAMETERS

Flows from Tributary Areas

Fairgrounds/West Gateway

Design Average Flow	=	0.52	MGD	(361 gpm)
Peak Hourly Flow	=	1.68	MGD	(1,167 gpm)
Infiltration & Inflow	=	0.00	MGD	(0 gpm)
Peak Wet Weather Flow		1.68	MGD	(1,174 gpm)

Youth Center

Design Average Flow	=	0.18	MGD	(125 gpm)
Peak Hourly Flow	=	0.65	MGD	(451 gpm)
Wet Weather Flow	=	1.00	MGD	(694 gpm)
Peak Wet Weather Flow		1.65	MGD	(1,145 gpm)

Influent Flows: (Note: Flows are not cumulative from above.)

Design Average Flow	=	0.70	MGD	(486 gpm)
Design Maximum Flow	=	1.75	MGD	(1,215 gpm)
Peaking Factor	=	3.11		
Peak Hourly Flow Rate	=	2.18	MGD	(1,514 gpm)
Peak Wet Weather Flow	=	3.33	MGD	(2,312 gpm)

Design Loading:

CBOD5 = 0.70 MGD x 240 mg/L x 8.34 lb/gal	=	1,401	lbs/day
TSS = 0.70 MGD x 260 mg/L x 8.34 lb/gal	=	1,518	lbs/day
NH_3-N = 0.70 MGD x 35 mg/L x 8.34 lb/gal	=	204	lbs/day

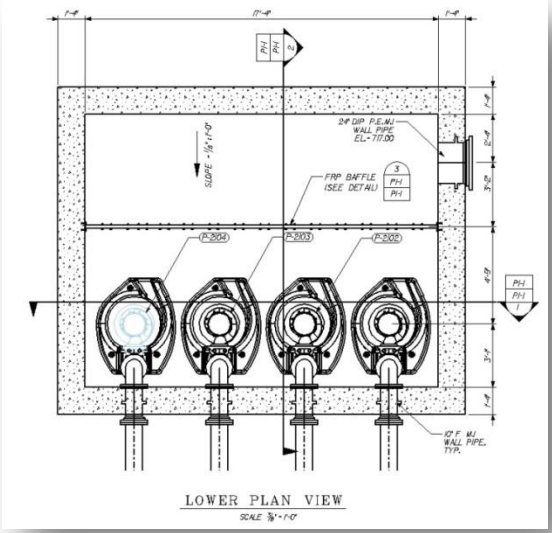
Design Effluent Parameters:

$CBOD_5$, 30 day avg.	=	10	mg/L
TSS, 30 day avg.	=	12	mg/L
NH3-N, 30 day avg. (Mar)	=	1.5	mg/L
NH3-N, 30 day avg. (Apr - Oct)	=	1.2	mg/L
NH3-N, 30 day avg. (Nov - Mar)	=	2.5	mg/L
pH, continuous range	=	6 – 9	

5.6. RAW SEWAGE PUMPING:

5.6.1. Process Description

The raw sewage pump station was constructed during the Phase II Expansion. The pump station includes a three pump system, with one pump providing back-up capacity. Space was provided for installation of a future, fourth pump. The system is designed with flow matching capabilities using two speed motors and pre-rotation basins.



5.6.2. 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. The following are excerpts from the applicable sections.

Section 370.410 Design

c) Pumps and Pneumatic Ejectors

1) Multiple Units

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

g) Ventilation

6) Dry Wells

Dry well ventilation may either be continuous or intermittent. Ventilation, if continuous, should provide at least 6 complete air changes per hour; if intermittent, at least 30 complete air changes per hour.

h) Flow measurement

Suitable devices for measuring sewage flow shall be provided at all pumping stations. Indicating, totalizing and recording flow measurement shall be provided at pumping stations with a 1200 gpm or greater design peak flow.

Section 370.550 Essential Facilities

a) Emergency Power or pumping facilities

1) All plants shall be provided with an alternate source of electric power or pumping capability to allow continuity of operation during power failures. Methods of providing power or pumping capability include:

A) The connection to at least two independent public utility sources …

B) Portable or in-place internal combustion engine equipment which will generate electrical or mechanical energy.

C) Portable pumping equipment when only emergency pumping is required.

5.6.3. Design Data

Number of pumps	3 (space for 1 additional)
Type	Wemco Hidrostal - Prerotation
Capacity, each	1,638 gpm at 37 ft. TDH
Force Main Dia., inches	14
Maximum Capacity of P.S.	3,275 gpm (one pump out of service)

5.6.4. Performance & Deficiencies

The IEPA Design Standards require the pump station to be capable of pumping the Peak Hourly Flow of 2.18 MGD (1,514 gpm) with one pump out of service. However, due to infiltration and inflow issues on the IYC Campus, the expected Peak Wet Weather Flow was 2,312 gpm. The pump station was designed to meet the long term Peak Wet Weather Flow of 3,680 gpm with 3 pumps in operation. Therefore each pump is capable of producing a minimum of 1,638 gpm, and a combined flow of 3,275 gpm. The pump station will be capable of producing 3,700 gpm with three pumps running. Therefore, the pump station meets all regulatory requirements at this time.

However, City staff has not utilized the pre-rotation system of the pump station, electing instead to operate with start and stop water levels similar to float back-up controls in a standard lift station. According to the City, the low speed on a single pump empties the wet well too quickly and experiences an excess number of starts and stops. Both start and stop water levels that have been in place over the last several years are above the pre-rotation channels, and debris has been allowed to build up in this wet well.

5.6.5. Recommendations

Without the pre-rotation system being utilized or the wet well getting cleaned out, the higher water level in the wet well has developed a build-up of grit in the dead zones north of the baffle wall. This has created operational issues with the submersible level sensor, which is located north of the baffle wall.

It is recommended that this wet well be cleaned out, and the pre-rotation system be utilized to prevent the build-up from occurring again. If any work is done within the wet well in the future, it is recommended that fillets be installed in the northwest and northeast corners to prevent material build-up. Finally, the lift station has space for a fourth pump that might be utilized for a smaller jockey pump to handle low-flow conditions. An alternate control system could be incorporated that would allow for either operational mode to be utilized. For example, the pre-rotation could be used for the majority of the day and the start-stop mode could be used for low-flow periods.

5.7. HEADWORKS – SCREENS

5.7.1. Process Description

The headworks provide a variety of functions, including mechanical screening, RAS blending and flow measurement. The facilities are located in the center of the Operations Building. Flow is received from the raw sewage pump station, passes through a magnetic flow meter, passes through the mechanical fine screen, and blends with RAS before it is conveyed to the extended aeration basins.

5.7.2. IEPA Regulatory Requirements

The Following are excerpts from Title 35 Subtitle C: Chapter II Part 370.610 Illinois Recommended Standards for Sewage Works

Where Required: Screening of raw sewage shall be provided at all mechanical treatment 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 facilitate maintenance.

Velocities through Screens: For manual and mechanically racked bar screens the maximum velocity during peak flow periods should not exceed 2.5 feet per second. The velocity shall be calculated from a vertical projection of the screen opening on the cross-sectional area between the invert of the channel and the flow line. Excessive headloss through the screen, which may affect upstream flow measurement or by-passing taken be taken into account.

5.7.3. Design Data

Number of channels	2
Number of Mech. Fine Screens	1
Capacity	6.0 MGD
Number of Manually Cleaned Screens	1
Maximum Clear Water Headloss, inches	11.0
Bar Spacing, inches	3/16
Nominal Screening Basket Diameter, inches	47

5.7.4. Performance and Deficiencies

The existing unit was installed in the Phase II Expansion. The expected service life for mechanical bar screens is fifteen years. This unit should be reaching the end of its service life in 2016 and should be considered for replacement at that time. Currently, the unit is performing very well with no lapses in service. City staff added a strainer and a clean-out to the non-potable water line immediately upstream of the screen wash-down system, which has prevented build-up of debris in this system. The screen's comb, rake and bearings are in need of replacement. These items are currently in inventory, and it is recommended that the City utilize their maintenance budget to replace them.

5.8. EXTENDED AERATION BASINS

5.8.1. Process Description

The aeration basins are a plug flow design with 24 hours detention time. The aeration basins biological loading is less than the 15 pounds BOD per 1,000 cubic feet of aeration basin volume which is the maximum loading criteria as determined by the Illinois Recommended Design Standards. The diffuser system is a medium bubble design in lieu of fine bubble aeration because the mixing requirements are greater than the oxygen transfer requirement for the lightly loaded basins. The aeration basin design includes a 14-foot side- water depth and common wall construction to minimize expansion costs and maximize diffuser efficiency.

5.8.2. IEPA Regulatory Requirements

Following is an excerpt from Title 35: Subtitle C: Chapter II: Part and 370.920 and 370.1210 Illinois Recommended Standards for Sewage Works.

Aeration Tank Organic Loading

Single Stage Nitrification 15 lbs BOD[5]/day/1000 cf

Hydraulic Retention Time

The hydraulic detention time shall be a minimum of 8 hours based on the plant design average flow as determined by Section 370.520.

5.8.3. Design Data

Number of Units	2 Proposed (2 Future)
Design Average Flow	0.70 MGD (486 gpm)
Peak Wet Weather Flow Rate	3.33 MGD (2,312 gpm)
BOD5	240 mg/L (1,401 lbs/day)
TSS	260 mg/L (1,518 lbs/day)
NH3-N	35 mg/L (204 lbs/day)
Surface Area	6,240 square feet
Side Water Depth	15 feet
Total Volume	93,600 cf (700,128 gal)
Biological Loading	14.97 lb/day/1,000 cf
Detention Time	24.00 hours
MLSS conc.	3,000 mg/L
Solids Inventory	17,517 lbs
Sludge Age	19.23 days
Oxygen Required	127 lbs/hr
Oxygen Supplied	127 lbs/hr

5.8.4. Performance & Deficiencies

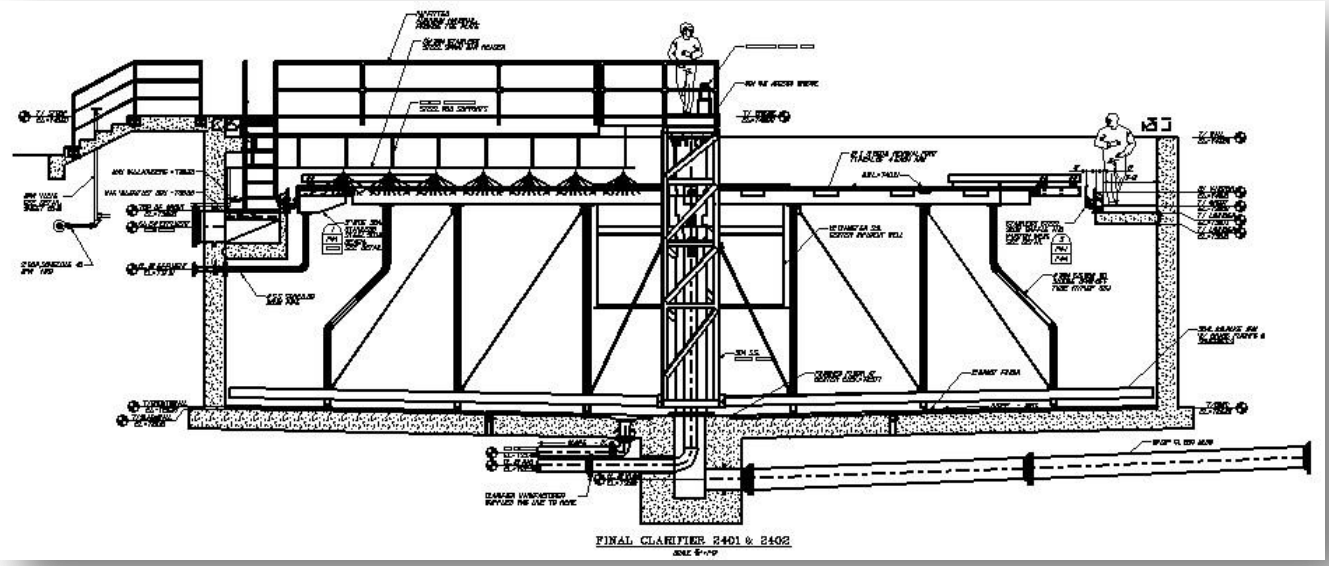
The Aeration basins design is adequate to treat the maximum monthly average for both BOD5 and ammonia. The process has performed exceptionally well and has been removing of 98% of each contaminant, despite the fact that the effluent weirs have corroded away. The diffuser system is a medium bubble diffuser which is very low maintenance, is not subject to fouling and does not require routine membrane replacement like fine bubble diffusers.

The effluent weirs in all of the basins have corroded away, and therefore the design detention time is not currently being met. The City is currently in the process of replacing these with stainless steel weirs. The Blowers for the air supply were installed in 2001 during the Phase II Expansion. The blowers and electrical components have been operating in an acceptable manner and are adequately sized to meet the existing and 0.70 MGD conditions. The blowers should therefore be considered for replacement for the Phase III Expansion. In addition, the flow meter that currently controls the blower speeds is nearing the end of its useful life and has experienced operational issues. This flow meter should also be replaced with the Phase III Expansion.

5.9. FINAL CLARIFIERS

5.9.1. Process Description

The West Side Water Reclamation Facility includes two hydraulic differential clarifiers. The clarifiers were constructed during Phase II Expansion project and design to meet tertiary standards. Therefore, the effluent does not require filtration prior to disinfection.



5.9.2. IEPA Regulatory Requirements

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

> *<u>Surface Settling Rates (Overflow Rates)</u>*
> *The hydraulic loadings shall not exceed 1000 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).*
>
> *<u>Solids Loading Rate</u>*
> *The solids loading shall not exceed 50 pounds solids per day per square foot at the design peak hourly rate.*

Weir Loading
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).

5.9.3. Design Data

Number of Units	2
Clarifier Diameter	60 feet
Side Water Depth	14' 0”
Surface Area	2,827 sf/clarifier
Solids Loading Rate	14.73 lbs/sf/day
Surface Loading Rate	589 gal/sf/day
Weir Overflow Rate	10,471 gal/lft/day @ PWWF

5.9.4. Performance & Deficiencies

The clarifiers were designed with a 14-foot side-water depth to allow the City to carry a sludge blanket within the clarifier. This blanket assists in developing a higher return sludge concentration. The clarifiers are covered with low-maintenance aluminum covers. The covers prevent algal growth and prevent freezing during winter operation. In addition, the mechanism is constructed of 304 series stainless steel, which prevents corrosion and extends the expected service life of the clarifier. Moreover, the performance data demonstrates that the clarifiers are capable of meeting tertiary effluent limits on a continuous basis.

The main drives have not been re-built since they were installed in 2000 and should be considered for repair or replacement. Also, the valves on the non-potable water service immediately south of the clarifiers might have been damaged by freeze-thaw cycles during the winters since installation. It is recommended that these services be investigated to determine the extent of the damage and make any necessary repairs. Finally, the ventilation system under the covers should be serviced in the near future. It is recommended that the City utilize their maintenance budget to perform this work.

5.10. ULTRA VIOLET DISINFECTION

5.10.1. Process Description

Traditionally chlorine has been the preferred disinfection technology. However, concerns over disinfection by-products, post treatment requirements, public safety, and chemical handling provided adequate reason for the design of the Phase II Expansion to incorporate ultraviolet disinfection.

Ultraviolet Disinfection is an environmentally friendly method of disinfecting wastewater. Microorganisms, including viruses, are inactivated when exposed to UV-C light in a controlled environment and dosage. The UV-C light with a frequency of 254 nanometers causes a physical reaction with the organisms' DNA. This reaction prevents cell division and reproduction of potentially dangerous organisms and viruses.

The design included a two-bank system with 12 lamps in each bank. The system was installed with adequate capacity to serve the build-out conditions.

5.10.2. Design Parameters

Number of Units	1 Proposed
Design	Horizontal (Trojan UV4000)
Design Average Flow	1.40 MGD (972 gpm)
Peak Wet Weather Flow	5.20 MGD (3,611 gpm)
TSS	24 mg/L
UV Transmission	65%

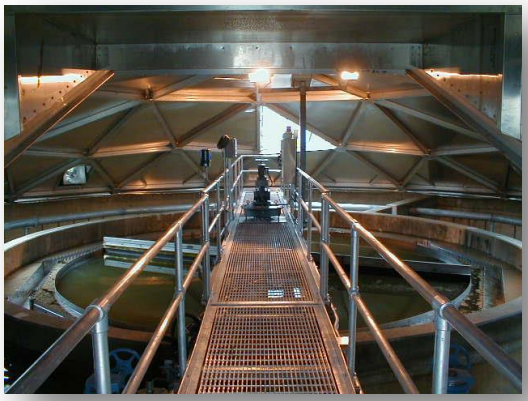
5.10.3. Performance & Deficiencies

The operational staff has stated that the disinfection facility meets their expectations. Maintenance and operational costs are very low. The system seems to be operating as designed, with the exception of the last couple years. Apparently, the build-up of daphnia and midge larvae on solids in the flow through this channel has affected the sensors that would automatically adjust the strength of the ultraviolet light put out by the system. The City staff has had to run the system in hand (at 100%) for the last couple years. The City should consider putting the system back in automatic mode to take advantage of the power-saving capabilities of the system. To address the larvae, the City could dose with Strike or similar chemical in the mixed liquor. In addition, some system upgrades to be considered in the future include upgraded controls, and replacement of the hoist and lamps.

5.11. SLUDGE STABILIZATION

5.11.1. Process Description

The existing 0.35 MGD package plant was converted to aerobic digestion during the Phase II Expansion. The package plant included a concentric circular design with basins on the exterior and a clarifier in the center. The conversion included replacement of the clarifier with a gravity thickener, installation of air-lift pumps for basin to basin transfer, installation of sludge transfer pumps to disposal and replacement of the aeration system.



5.11.2. Design Parameters

<u>Sludge Thickening:</u>	
Design	Gravity Thickening
Diameter	32.5 ft
Side Water Depth	13.5 ft
Volume	83,770 gal
Surface Area	829 square feet
Peak Loading Rate	400 gal/sf/day
	(160 gpm WAS & 70 gpm from Digester)
Influent Flow @ 1%	10,900 gpd
Waste to Digester @ 2.5%	4,360 gpd
<u>Aerobic Digestion:</u>	
Number of Units	2
Total Volume	33,630 cf
Detention Time @ 2.5%	57.6 days
<u>Digested Sludge Storage:</u>	
Number of Units	1
Total Volume	9,810 cf
Detention Time	16.8 days

5.11.3. Performance & Deficiencies

The operational staff has stated that the gravity thickener has caused high BOD and TSS concentrations in the recycle flow at times. These situations occurred when solids had built up in the system and the City was not able to dispose of solids on a timely basis. It appears that these issues have been addressed which is reflected in the plant's performance of the last two years. Additional decant capabilities could be added to digesters 2 and/or 3 to increase digested sludge concentrations. Future expansions should consider construction of additional sludge storage and/or sludge dewatering facilities.

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SECTION 6

UPGRADE AND EXPANSION PLAN

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6. UPGRADE AND EXPANSION PLAN

6.1 GENERAL

Section 5 provided an analysis of the current West Side WRF infrastructure condition, biological and hydraulic loading. The existing facility is in excellent condition, therefore rehabilitation needs are limited to common replacement items. The analysis within Section 5 also demonstrated that the strength of the wastewater is consistent with the original design parameters. In addition, the influent flows are approximately 78 gcd which is similar to the 67 gcd billed to users, therefore infiltration and inflow are minimal.

The service area continues to be developed in accordance with the City's Comprehensive Plan. The analysis presented in Section 5 demonstrated that the West Side WRF is operating at approximately 69% of its design capacity. The City has committed to serve the Department of Corrections which equates to 40,832 gpd, or an additional 6%. The total committed capacity is 75% of design. The Illinois EPA places facilities over 80% of design on Critical Review to ensure that permitting does not exceed design capacity. Once the influent flow and outstanding permits reach 100% of the design capacity, the facility is placed on Restricted Status and additional connections will not be permitted until the facility has been expanded. The City of St. Charles has approximately 318 PE remaining prior to being placed on Critical Review, and approximately 1,718 PE remaining prior to being placed on Restricted Status.

The Northeastern Illinois Planning Commission (now CMAP) and Illinois EPA approved the Phase 2 and Phase 3 Expansions in their review of the 1998 Facility Plan Update. The Illinois EPA requested that a Facility Plan Update be provided prior to approval of the originally recommended Phase 4 – 1.40 MGD expansion. The analysis provided in Section 2 demonstrates that the existing 0.7 MGD has capacity to serve approved development. Phase 3 – 1.05 MGD will be required to serve future development within the West Service Area. The Phase 4 – 1.40 MGD expansion would be recommended when the forecasted hydraulic loading from the additional property, pending development or redevelopment would result in an average daily flow of 0.84 MGD.

Expansion of the treatment facility will require upgrade of the biological process to address recently promulgated and pending environmental regulations. The regulatory issues that should be addressed within this section include nutrient removal, suspended solids effluent requirements, and bio-solids stabilization. Other issues include anti-degradation requirements, and copper and radium concentrations in the effluent.

6.2 REGULATORY ISSUES

6.2.1 Biological Nutrient Removal

In 2004, the Illinois EPA implemented additional nutrient removal criteria for wastewater treatment facilities that were proposing expansion of hydraulic capacity. Two nutrients of concern are total nitrogen (TN) and total phosphorus (TP). At this time, the anticipated limits are 8 mg/L and 1 mg/L for TN and TP, respectively.

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. Phosphorous 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 phosphorous removal, a small amount of which occurs in all activated sludge processes in which activated sludge is wasted.

Greater amounts of phosphorous 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 microorganisms are not capable of storing large amounts of ATP and rely on a constant rate of metabolism to maintain cellular activity. Certain microorganisms known as Phosphorus Accumulating Organisms (PAOs) can store significantly more phosphorous than other heterotrophic bacteria. PAOs are capable of survival in an anaerobic environment absent of nitrate and oxygen. As such, the percentage of PAOs within the microbiological community increases when the process includes an anaerobic zone. The larger PAO population ensures a higher concentration of phosphorus within the sludge wasted from the process.

It has been documented that anaerobic zones are needed to provide an environment where the PAOs are allowed to metabolize influent organic material with limited competition from other organisms. In this environment, the PAOs release phosphorus and metabolize the readily biodegradable Chemical Oxygen Demand (rbCOD). In downstream aerobic zones, the PAOs 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."*

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 anticipated future 1 mg/L effluent standard. Therefore, chemical polishing capabilities would be incorporated into a biological phosphorus removal design.

It is important to note that the phosphorous 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.

Due to anti-degradation requirements, expanded facilities must provide for the reduction of TN. The most common application for nitrogen removal includes the incorporation of anoxic zones into the biological process. This approach to wastewater treatment is called Biological Nutrient Removal (BNR). The existing biological process was designed for conversion of soluble bio-degradable organic contaminants and nutrients, specifically ammonia nitrogen. Raw wastewater is anaerobic and therefore the majority of nitrogen is in the form of ammonia. 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 (NH_3) to nitrite (NO_2). Nitrite is oxidized to nitrate (NO_3) by nitrobacter and similar microorganisms. Denitrification is an anoxic process where organisms reduce nitrate to nitrogen gas (N_2). The driving mechanism for denitrification is the microorganisms need to obtain the oxygen molecule for respiration. This process is more efficient when microorganisms have a readily available carbon source.

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. Commonly implemented BNR processes include simultaneous nitrification/denitrification, A/O, A^2/O, Bardenpho, UCT, MLE, and the Modified Johannesburg.

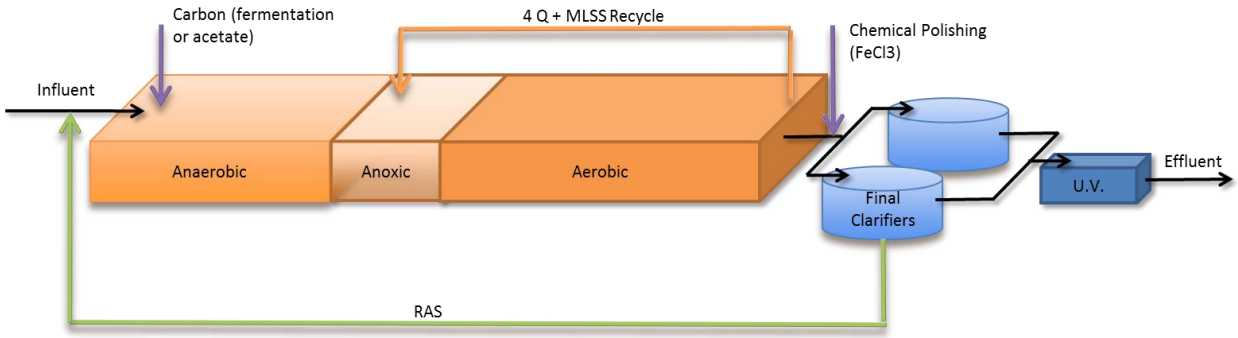
Simultaneous nitrification/denitrification processes include oxidation ditches, vertical-loop reactors, and the Sym-Bio™ process. While the oxidation ditch design is common, the existing basins cannot be readily converted to this configuration. The vertical-loop reactor design requires a basin depth of roughly 20 feet; the existing basins have a 15 foot side water depth. The Sym-Bio™ process is probably more applicable to a treatment facility that receives high-strength waste.

The A/O process only addresses phosphorus removal, and would require the implementation of denitrification filters to address TN limits. The A^2/O is a simple process that provides anaerobic, anoxic and aerobic conditions that addresses both TP and TN.

The A^2/O configuration of the biological process utilizes three zones. The head of the process is an anaerobic zone, followed by an anoxic and an aerobic zone. The zones would be split by the construction of baffle walls within the existing basins. An internal recycle of approximately 4 times the design flow from the end of the aerobic zones is conveyed to the head of the anoxic zones. This internal recycle will denitrify approximately 80% of the flow. Based on an estimated 35mg/L influent TN, effluent TN would be reduced to roughly 7 mg/L. Higher return rates are possible, which would result in lower TN. For example, a recycle rate of 6Q would theoretically achieve 5 mg/L. The existing basins are not detention-time limited, therefore implementation of this process should include additional internal recycle capacity to provide operational flexibility. Return rates higher than 6Q may become a limiting factor, and therefore a separate process such as denitrification filters may be required to reliably achieve a TN below 5 mg/L.

Successful implementation of this process is highly dependent on the availability of readily available bio-degradable COD and the formation of volatile fatty acids (VFAs). VFAs are naturally formed by the anaerobic degradation of raw wastewater, and this process commonly occurs in the collection system. However, the West Service Area is a relatively small basin, and anaerobic degradation of the raw wastewater may be limited. Furthermore, the level of degradation will be seasonal due to changes in temperature of the raw wastewater. Two recommended methods to address this issue include implementation of a fermenting process or the addition of an auxiliary carbon source such as acetate. As mentioned previously, the process is sensitive to changes in temperature, flow and feed concentration. BPR may not be able to continuously meet the anticipated future 1 mg/L effluent standard. Therefore, chemical polishing capabilities would be incorporated into a biological phosphorus removal design.

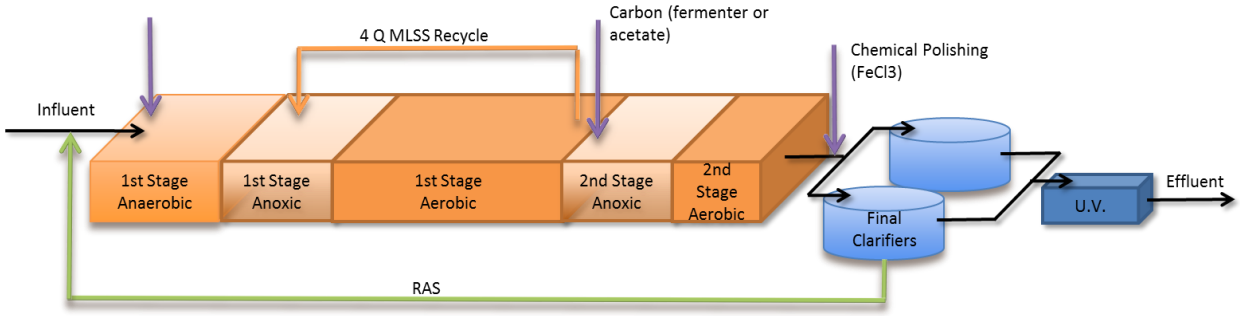
Exhibit 6-1 | West Side WRF – A^2/O Process



Originally developed by Dr. James Barnard, the Five-Stage Bardenpho 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 4 times the design flow from the end of the first aerobic zones is conveyed to the head of the first anoxic zones. This internal recycle will denitrify approximately 80% of the flow, and will require implementation of a methanol feed system to denitrify the remaining 20%.

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 zones would be split by the construction of baffle walls within the existing basins. The typical Five-Stage Bardenpho process requires approximately 14 hours of hydraulic retention time. The existing basins provide approximately 24 hours retention at design flow, and should be able to achieve the effluent nutrient limits consistently within the biological process. Even with this enhanced BNR process, some chemical addition for polishing (i.e. Ferric Chloride or Alum) may be required to continuously meet the an effluent TP limit of 1 mg/L.

Exhibit 6-2 | West Side WRF – Five-Stage Bardenpho Process



The MLE process was designed to specifically address TN, and must be modified to address TP. This process is therefore traditionally implemented in conjunction with chemical phosphorus removal. The UCT and the Modified Johannesburg are very similar processes that have multiple internal recycle streams and were developed to address site-specific issues commonly associated with recycle flows from side stream processes. The existing facility utilizes aerobic digestion, and side stream processes are not anticipated to present an issue.

Therefore, the A^2/O and Five-Stage Bardenpho are considered to be the top two candidates for BNR at the West Side WRF. The A^2/O is simpler to implement, while the Five-Stage Bardenpho provides increased flexibility and lower TN. The anticipated effluent TN limit is 8 mg/L. If the A^2/O is designed with an internal recycle capacity of 6Q, both processes can meet this limit. The TN limit could be 5 mg/L in the future, and the Bardenpho will then be the more applicable process. For the purposes of this report, the Bardenpho is the selected alternative.

6.2.2 Chemical Phosphorus Removal

The City has several options for the chemical precipitation of phosphorus. Lime addition is effective but produces a considerable amount of sludge. Alum and iron salts are more commonly recommended. The locally available iron salts include ferric chloride ($FeCl_3$) and ferrous sulfate ($FeSO_4$). Both are highly corrosive and should be stored in a separate, well-ventilated area.

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. Chemical precipitation in the secondary process increases the settling ability of the flocculation within the clarifiers and potentially improves effluent TSS.

Since 2010, the effluent phosphorus concentrations from the West Side WRF have been approximately 2.9 mg/L. The chemical precipitation required for phosphorus removal is estimated to be one mole of iron (Fe) for one mole phosphorus (P). However, an additional one to five moles of iron is required to satisfy competing reactions, such as hydroxide formation. Influent to both the Main WWTF and West Side WRF have similar waste characteristics. Jar testing at the Main WWTF identified an actual chemical relationship of 4 moles chemical dose per mole of phosphorus removed. It is estimated that sludge production from chemical precipitation in the process will yield four times the influent pounds of phosphorus removed, which would increase the overall secondary sludge production by roughly 28%.

The chemical precipitation required for phosphorus removal for secondary treatment is based on an estimation of four moles (1 mole + 3 moles additional) per mole of phosphorus. This includes one mole of iron (Fe) for one mole phosphorus (P) and an additional 2 moles of iron to satisfy competing reactions, such as hydroxide formation. The calculations for ferric chloride ($FeCl_3$) addition at 35% solution strength are as follows:

<u>Determine Parameters of $FeCl_3$ and PO_4</u>

Molecular Weight of PO_4 = 95 g/mole

Moles / Pound of PO_4 = 453 g/lb. / 95 g/mole = 4.768 moles of PO_4 / pound

Molecular Weight of $FeCl_3$ = 164 g /mole

Moles / Pound of $FeCl_3$ = 453 g/lb. / 164 g/mole = 2.78 moles of $FeCl_3$ / pound

Weight of $FeCl_3$ per gal of solution = 11.23 lb. /gal x 35% = 3.93 lb. of $FeCl_3$ / gal

3.93 lb. of $FeCl_3$ / gal x 2.78 moles / pound = 10.9 moles of $FeCl_3$ per gallon

Determine $FeCl_3$ dosage for Secondary Treatment (use 4 moles $FeCl_3$ / per mole PO_4)

4 mol $FeCl_3$ per mole of PO_4 x 4.768 mol PO_4 / lb. PO_4 = 19.072 mol $FeCl_3$ /lb. PO_4

19.072 mol $FeCl_3$ / lb. PO4 / 10.9 mol $FeCl_3$ / gal $FeCl_3$ = 1.75 gals $FeCl_3$ / lb. PO_4

Use 1.8 gallons of FeCl3 per pound PO_4

Determine Required Volume of $FeCl_3$

At a DAF of 1.05 MGD,

6 mg/L x 1.05 MGD x 8.34 = 52.5 lbs. PO_4 /day

1.8 gallons $FeCl_3$ /lb. PO_4 x 52.5 lbs. PO_4 /day = 94.5 gallons $FeCl_3$ /day

Determine Required Dosage Rate of $FeCl_3$

(94.5 gallons $FeCl_3$ /day x 11.23 lbs. /gal) x 35% = 371 lbs. $FeCl_3$ /day

371 lbs. / (8.34 lbs. /gal x 1.05 MGD) = 42.4 mg/L

The calculated dosing requirements for secondary treatment equate to a daily usage of approximately 95 gallons. This is approximately 4 gallons per hour, which may vary throughout the day due to the extremely low influent flows overnight. For 30 day's storage, the City would need to have approximately 2,850 gallons onsite. The capital cost estimate and annual cost analysis for implementing chemical phosphorus removal to attain a 1.0 mg/L limit are shown below.

Table 6-1 | Probable Cost for Chemical Phosphorus Removal to 1.0 mg/L

GENERAL CONDITIONS	$126,000
SITE WORK	$134,000
CHEMICAL FEED SYSTEM	$485,130
CONSTRUCTION SUBTOTAL	$745,130
CONTINGENCY @ 20%	$149,026
CONSTRUCTION TOTAL	$894,156
PROJECT ENGINEERING (14%)	$125,182
TOTAL PROJECT COST	$1,019,338

Table 6-2 | Chemical Cost Analysis for TP = 1.0 mg/L

DAF (MGD)	Phosphorus (Lbs/day)	Phosphorus (Lbs/ Year)	FeCl3 (Gallons/year)	Estimated Annual Cost
1.05	53	19,345	34,821	$34,821

6.2.3 Bio-Solids Stabilization

Bio-solids stabilization is the process of reducing the amount of volatile matter in the sludge produced by the wastewater treatment process. There are numerous stabilization processes that are commonly used including aerobic digestion, anaerobic digestion, and composting. Other technologies that have been recently introduced to the industry include thermophilic aerobic digestion, lime stabilization, heat pasteurization, and others.

The USEPA and the Illinois EPA govern the reuse and disposal of bio-solids. The USEPA document governing the land application of sewage sludge is commonly referred to as 40 CFR Part 503 and was promulgated in February of 1993. Under the Section 503 regulations there are three classifications of stabilized bio-solids; Class B, Class A and Class A-EQ (exceptional quality). The Illinois EPA guidelines for application of bio-solids are provided in Title 35, Subtitle C, Chapter II, Part 391.

The USEPA standards for Class B bio-solids include requirements for fecal and vector attraction reduction. Class B sludge can be land applied under a site specific Sludge Disposal Permit (SDP). The property, which receives Class B sludge, cannot be used for growing crops for direct human consumption and must have limited public access. The City currently uses the aerobic digestion process to produce Class B bio-solids and land applies on open land adjacent to the site. However, while some contaminants are regulated at agronomic uptake rates, others such as heavy metals do not degrade over time. Repeated applications of these contaminants will therefore be cumulative, limiting the number of applications for a particular site.

Class A bio-solids are processed to a higher degree than Class B ensuring a more complete destruction of pathogenic organisms. Pathogen reduction to Class A standards ensures that bio-solids are safe to be used in locations where human contact is likely. The USEPA identifies two classifications of processes to achieve Class A Bio-solids standards: a process to significantly reduce pathogens (PSRP) and a process to further reduce pathogens (PFRP). PSRP processes are pre-approved processes that meet specific criteria for and include pasteurization or pathogen destruction and do not require further testing. PFRP processes are capable of meeting fecal and vector attraction requirements however require laboratory testing and monitoring to demonstrate that that bio-solids meet the Class A standards. Thermophilic anaerobic and aerobic digestion, and composting are examples of PFRP processes.

Class A EQ bio-solids meet the strict requirements for stabilization and do not exceed the maximum contaminant level (MCL) for a number of inorganic compound and metals. The bio-solids that have been treated by an approved process or have been laboratory tested to prove the prescribed volatile solids destruction or fecal count and meet the MCL for the regulated inorganic compounds may be disposed of without a site specific disposal permit. For example, if the City of St. Charles produced a sludge, which could meet the requirements for Class A EQ bio-solids under the Federal 503 Regulations, then the bio-solids could be used in place of topsoil for parkway restoration, or landscaping throughout the City, given away to landscaping companies or even sold as an alternative to topsoil.

The Illinois EPA has not yet updated their regulations to be consistent with the Federal Regulations and therefore does not distinguish between Class A EQ, Class A and Class B bio-solids. However, some communities in Illinois have petitioned the IEPA and proven that the bio-solids meet Class A EQ standards, resulting in permission to dispose of the bio-solids without a site-specific permit. IEPA may update their regulations in the future.

In summary, the City's current aerobic digestion and land application system is consistent with current regulations. While the West Side Services area does not include any known sources that would prevent the City from upgrading the process to meet Class A EQ Bio-solids, the cost of pursuing this classification cannot be justified at this time. Therefore it is recommended that the City continue to utilize the existing aerobic digestion process.

6.3 EXPANSION REQUIREMENTS

Section 2 of the report provides updated population projections based on the City's revised comprehensive plan. The West Side Service Area served 6,275 PE in 2013 and the West Side WRF treated 0.49 MGD of wastewater. Taking into consideration ongoing development, governmental capacity commitments, and potential annexations, the population equivalent of the service area will eventually be increased by 6,111 PE. This equates to a build-out projection of 12,386 PE at an average daily flow (ADDF) of 1,110,000 gal/day or 1.11 MGD

Table 6-3 | Projected Population and Wastewater Flows

Description	2013 Conditions		Current Development		Build-Out Projection	
	PE	ADDF (MGD)	PE	ADDF (MGD)	PE	ADDF (MGD)
Renaux Manor Basin	1,758	0.14	414	0.04	3,320	0.29
Pine Ridge Basin	11	0.001	65	0.006	326	0.03
Zylstra Basin	280	0.02	0	0.00	320	0.04
Gravity Basin	4,226	0.33	0	0.00	8,420	0.75
Total	**6,275**	**0.49**	**479**	**0.046**	**12,386**	**1.11**
Peaking Factor		3.15		3.98		2.86
Peak Hourly Flow (MGD)		**1.54**		**0.18**		**3.18**

The current West Side WRF has a capacity of 700,000 gallons per day (0.700 MGD). The 2013 wastewater projections for this service area are 487,350 gallons per day. This value includes 40,832 gpd committed for increased flow from the Department of Corrections that the City agreed to when the West Side WRF was purchased. Therefore, the remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. Current development will create an average daily flow of approximately 0.54 MGD, and not require the expansion of the West Side WRF. However, build-out conditions will require expansion. When the average influent reaches 80% of its design flow, or 0.56 MGD, it is recommended that the City begin planning for the expansion of the West Side WRF. In summary, the facility will need to construct Phase 3 in the near future to support the projected build-out of the service area.

6.4 PHASE III IMPROVEMENTS

The West Side Water Reclamation Facility's current capacity is 700,000 gallons per day, or 0.70 MGD. The facility was designed to be expanded in 350,000 gallon per day increments with an ultimate capacity of 1.4 MGD. Phase III would increase the facility's capacity from 0.7 MGD to 1.05 MGD. The necessary improvements were clearly laid out in the 1998 Facility Plan. Changes in the regulatory environment have added requirements for TN and TP removal. These regulatory changes will require modification to the existing aeration basins.

6.4.1 General Description

Phase III will include the addition of one raw sewage pump, upgrade of the biological process for expansion and removal of TN and TP, construction of an additional tertiary clarifier or construction of tertiary filters, upgrade of the aerobic digestion process, and the addition of on-site sludge dewatering and 150 days ultimate sludge storage capacity.

The additional raw sewage pump will include the purchase and installation of the same pump as the three that are currently in place. Piping and electrical provisions have been made for the pump during the Phase II Expansion.

The preliminary treatment screening structure was originally designed to handle the maximum wet weather flow. As a result, the only improvements required are the installation of a second screen.

As discussed previously, the existing aeration basins will be modified to include a five step process including anaerobic, anoxic and aerobic basins. An additional process train of basins shall be constructed to maintain the twenty-four hour detention time. Additional blowers will be required to meet the increased loading requirements. Chemical addition for nutrient polishing will be incorporated into the design as well.

The City evaluated alternatives for tertiary treatment including construction of filters in comparison with continuing to utilize tertiary clarifiers. The final clarifiers constructed in Phase II are adequate for the ultimate peak wet weather flow. As a result, the clarifiers would not need to be expanded for Phase III if tertiary filters were constructed. There are several alternative designs for tertiary filters. The preferred design includes a continuous backwash, which will minimize peak flows from the filters. The filters would require construction of a building to prevent freezing during the winter operation as well as a re-aeration channel or basin to meet the 6.0 mg/L minimum of dissolved oxygen per the NPDES permit.

Alternatively, the City could construct an additional tertiary clarifier. This clarifier would not require construction of a building or re-aeration channel. In addition, clarifiers typically require significantly less maintenance than filter systems. The City elected to defer this decision until the preliminary design phase. During that phase facility staff will visit several filter installations to evaluate the maintenance and operational costs associated with the tertiary filter alternative.

The aerobic digestion facility as improved in Phase II will be adequate through Phase IV design flow of 1.4 MGD. However, additional sludge storage volume will be required to meet the Illinois EPA requirements. The City has ceased liquid application as the site has been encumbered by additional uses. The City currently contracts for dewatering or hauls solids to the Main WWTP for dewatering. Phase III will include installation of dewatering equipment on site. In addition, the City will be constructing dewatered sludge storage to service both the West Side WRF and the Main WWTF.

6.4.2 Phase III Design Loading

Influent Flows:

Design Average Flow	=	1.05	MGD	(729 gpm)
Design Maximum Flow	=	2.63	MGD	(1,826 gpm)
Peaking Factor	=	2.93		
Peak Hourly Flow Rate	=	3.08	MGD	(2,139 gpm)
PHF + Tertiary Filter Return (TFR)	=	3.44	MGD	(2,389 gpm)
Peak Wet Weather Flow (PWWF)	=	4.10	MGD	(2,847 gpm)
PWWF + TFR	=	4.46	MGD	(3,097 gpm)

Waste Characteristics:

Influent BOD_5 =	2,102 lbs./day	240 mg/L
Influent rbCOD =	1,051 lbs./day	120 mg/L
Influent TSS =	2,277 lbs./day	260 mg/L
Influent NH_3-N =	219 lbs./day	25 mg/L
Influent TKN =	328 lbs./ day	38 mg/L
Influent P =	53 lbs./day	6 mg/L
Return Activated Sludge NO_3	16 lbs./day	3 mg/L

6.4.3 Anticipated NPDES Permit Limits

Flow	
Design Average Flow, MGD	1.05
Design Maximum Flow, MGD	2.63
CBOD5	
Monthly Average, mg/L	10
Monthly Average, lbs.	88
Daily Maximum, mg/L	20
Daily Maximum, lbs.	175
Suspended Solids	
Monthly Average, mg/L	12
Monthly Average, lbs.	105
Daily Maximum, mg/L	24
Daily Maximum, lbs.	210
Fecal Coliform	
Monthly Maximum (May-Oct. Geometric Mean)	200 per 100 ml
pH	
Range	6 - 9
Chlorine Residual	
Daily Maximum, mg/L	0.05

Ammonia Nitrogen

March	
Monthly Average, mg/L	1.5
Monthly Average, lbs.	13
Weekly Average, mg/L	3.8
Weekly Average, lbs.	33
Daily Maximum, mg/L	4.9
Daily Maximum, lbs.	43
April through October	
Monthly Average, mg/L	1.2
Monthly Average, lbs.	11
Daily Maximum, mg/L	3.0
Daily Maximum, lbs.	26
November through February	
Monthly Average, mg/L	2.5
Monthly Average, lbs.	22
Daily Maximum, mg/L	6.6
Daily Maximum, lbs.	58

Dissolved Oxygen

March through July	
Weekly Average (not less than), mg/L	6
Daily Minimum, mg/L	5
August through February	
Monthly Average (not less than), mg/L	5.5
Weekly Average (not less than), mg/L	4
Daily Minimum, mg/L	3.5

6.4.4 Process Summary

The Phase III process shall include a raw sewage pump station, screening, extended aeration, oversized clarification, tertiary filters, ultra-violet disinfection, sludge thickening and aerobic digestion. The following is a listing of process components and their associated sizes.

Raw Sewage Pump Station:

Number of pumps	4
Type	Pre-Rotation
Capacity, gpm each	1,550
Force Main Dia., in.	14
Maximum Capacity of P.S., gpm	4,200

Screens:

Number of Screens	2
Type	Lakeside Rotomat
Capacity, MGD Each	6.0

Biological Process:

Design	5-Stage BNR
Design Average Flow	1.05 MGD
Number of Trains	3
Volume, 1st stage Anaerobic cu. ft.	11,700
Volume, 1st stage Anoxic cu. ft.	23,400
Volume, 1st stage Aerobic cu. ft.	81,900
Volume, 2nd stage Anoxic cu. ft.	14,625
Volume, 2nd stage Aerobic cu. ft.	8,775
Volume, total cu. ft.	140,400
Volume, total, gal.	1,050,192
Detention Time at 1.05 MGD, hrs.	24.0
Organic Loading, lbs. /day BOD_5	2,102
Organic Loading Rate, lbs. /day BOD_5/1,000 cu. ft.	15
MLSS, mg/L	3,000
Solids Inventory, lbs.	26,271
WAS, lbs. /day	1,576
WAS Volume at 0.75% TS, gpd	25,200
Air Required Reduction , scfm	1,692
Air Provided, scfm	5,308
Sludge Age, days	16.66
F/M Ratio	0.08
PD Blowers for Anoxic (3), scfm each	525 @ 6.7 psi
Centrifugal Blowers (4), scfm each	1,700 @ 7.0 psi

MLSS Diversion Structure:

Number of Units	1 Proposed
Design Average Flow + RAS + TFR	1.87 MGD
PHF + Tertiary Filter Return (TFR) + RAS	5.37 MGD
Peak Wet Weather Flow (PWWF) + TFR+ RAS	6.39 MGD

Final Clarifiers:

Number of Units	2 Existing
Design	Center Feed
Design Average Flow, MGD each	0.525
Design Average Flow, gpm each	(364)
Peak Hourly Flow Rate, MGD each	1.54
Peak Hourly Flow Rate, gpm each	(1,069)
PWWF + TFR, MGD	2.23
PWWF + TFR, gpm	(1,550)
Clarifier Diameter, ft.	60
Side Water Depth	14' 9”
Surface Area, sq. ft. /clarifier	2,827
Solids Loading, lb. / sq. ft. /day	29.07
Surface Loading, gal / sq. ft. /day	789
Weir Loading, gal / lin. ft. / day	6,445
Influent Dia.	16"
Effluent Dia.	14"
Return Sludge Dia.	8"
Waste Sludge Dia.	4"

Tertiary Filters (*actual equipment selection to be updated during design phase*):

Number of Units	16
Design	UpFlow Gravity
Future Peak Wet Weather Rate	5.2 MGD
Area, sq. ft. each:	50
Total Area, sq. ft.	800
Backwash Rate, gpm each:	8
Total Recycle, gpm	128
Air Required, scfm each	3
Total Air Required, scfm	48
Headloss, ft.	2

Re-aeration Basins:

Number of Units	2
Volume, cu. ft. each	12,000

Air Required, scfm total	246

Ultra-Violet Disinfection:

Number of Units	1 Existing
Design	Horizontal
Design Average Flow, MGD	1.05
Peak Hourly Flow, MGD	3.08
Peak Hourly Flow, gpm	2,139
PWWF, MGD	4.10
PWWF, gpm	2,847
TSS, mg/L	10
UV Transmission	65%

RAS Pumping:

Design	Pre-rotations
Number of Pumps	4
RAS Pump Capacity each, gpm	500
RAS Force Main Dia.	2 - 8"

WAS Pump Station: (Reuse existing package plant Raw Sewage Pump Station)

Design	Dry pit immersible
Number of Pumps	2 existing
WAS Pump Capacity, gpm	160
RAS Force Main Dia.	4"

Sludge Handling – Aerobic Digestion:

Sludge Thickening:

Design	Gravity Thickening
Diameter, ft.	32.5
Side Water Depth, ft.	13.5
Volume, gal	83,770
Surface Area, sq. ft.	829
Peak Loading Rate, gal/ sq. ft. / day	400
	(160 gpm WAS & 70 gpm from Digester)
Influent Flow @ 0.75%, gallons / day	25,200
Waste to Digester @ 2.5%, gallons / day	7,559

Aerobic Digestion:

Number of Units	3
Side Water Depth, ft.	15
Digester 801, cu. ft.	9,810
Digester 802, cu. ft.	17,175
Digester 803 (sludge storage), cu. ft.	16,455
Total Volume, cu. ft.	26,985
Loading Rate, cu. ft. / PE	3.2
VSS Reduction, %	46
Detention Time, days	43.2

Proposed Dewatering

Design	Centrifuge
Number of Units	2
Capacity, gpm	80
Capacity, lbs. / hr.	800

Proposed Digested Sludge Storage:

Number of Units	2
Total Volume (West Side WRF + Main WWTP), cu. ft.	92,091
Dimensions, sq. ft.	31,000

6.4.5 Design Calculations

Raw Sewage Pump Station:

The pump station will serve 10,500 PE, therefore the calculated Daily Average Flow equals 1.05 MGD and Peak Hourly Flow Rate equals 3.08 MGD. The tertiary filter return rate is anticipated to be 0.36 MGD. The additional wet weather flow for this pump station could be as high as 1.0 MGD.

Phase III

Design Average Flow	=	1.05	MGD (729 gpm)
Design Maximum Flow	=	2.63	MGD (1,826 gpm)
Peak Hourly Flow Rate	=	3.08	MGD (2,139 gpm)
PHF + Tertiary Filter Return (TFR)	=	3.44	MGD (2,389 gpm)
Peak Hourly Flow (PWWF) + TFR	=	4.46	MGD (3,097 gpm)

Phase III Sequence of Operations

Phase III controls shall be set up for the alternation of four pumps however only three shall be available in this phase. Flow pacing shall be accomplished by using the pre-rotation basins. Lead pump ON elevation shall be 715.0 and the pump OFF elevation shall be 712.0. The Lag #1 pump shall start at an elevation of 717.0 and shut off at 713.0. The high level alarm shall be sent to the PC based system if water level reaches 717.5.

Wet Well Volumes

Bottom Elevation = 712.0
Volume from 712.0 to 715.0 = 19.73' x 17.37' x 3.0' x 7.48 gal/cu. ft. = 7,690 gallons
Volume from 715.0 to 717.0 = 19.73' x 17.37' x 2.0' x 7.48 gal/cu. ft. = 5,126 gallons
Volume from 717.0 to 717.5 = 19.73' x 17.37' x 0.5' x 7.48 gal/cuft = 1,282 gallons
Total Volume 14,098 gallons

Phase III Cycle Time for at Q = 365 gpm (1/2 Average Daily Flow)

Fill time from 712.0 to 715.0	=	21 minutes
Pump 101 start at 700 gpm & pump down	=	23 minutes
Fill time from 713.0 to 715.0	=	21 minutes
Pump 101 start at 700 gpm & pump down	=	23 minutes
Fill time from 713.0 to 715.0	=	21 minutes
Pump 101 start at 700 gpm & pump down	=	23 minutes
Total Cycle Time per Pump (3 in operation)	=	132 minutes

Headloss Calculations
Hazen-Williams formula:

$$H = \left(\frac{147.85 \times Q_{gpm}}{C \times d_{in}^{2.63}}\right)^{1.852}$$

Where:

H = Head loss per 1,000 feet of pipe
C = 120 (assumed same for friction and minor losses)
d = Diameter in inches
Q = Flow in gpm

P-101, P-102 & P-103:

Discharge Elevation, ft. =	=	742.43
Centerline intake elevations, ft.	=	711.60
Static Head, ft.	=	30.83 feet

Find Equivalent pipe lengths for fittings

Section One

1 - 6” 90 Elbow	16' of 6” pipe
6” x 10” Reducer	4' of 6" pipe
Forcemain	2’ of 6” pipe
	22' of 6" pipe (1 pump)

Section Two	
3 - 10” 90 Elbow	75' of 10” pipe
1 - 10" Check Valve	42' of 10" pipe
1 - 10" Plug Valve	7' of 10" pipe
Forcemain	45’ of 10” pipe
	169' of 10" pipe (1 pump)
Section Three	
Tee - Side Out	66’ of 14” pipe
Forcemain	2' of 14" pipe
	80' of 14" pipe (1 pump)
Section Four	
Run of Tee	22' of 14" pipe
Forcemain	2' of 14" Pipe
	26' of 14" pipe (2 pumps)
Section Five	
4 - 14" Run of Tee	88' of 14" pipe
3 - 14" 90 elbows	98’ of 14" pipe
2 - 14" Plug Valve	17' of 14" pipe
2 – Tee - Side Out	131’ of 14” pipe
Forcemain	26' of 14" pipe
	360' of 14" pipe (2 pumps)

For Q = 700 GPM (Pump 101 operating):
6" pipe H = (10.92) / 1000' of pipe x 22’ of pipe = 0.24’
10" pipe H = (3.68) / 1000' of pipe x 169' of pipe = 0.62'
14" pipe H = (0.72) / 1000' of pipe x 466' of pipe = 0.25'
H_{tot} @ 700 GPM = 0.24 + 0.62 + 0.25’ + 30.83’ static = 31.94 feet

For Q = 1,550 GPM (Pump 101 operating):
6" pipe H = (193.27) / 1000' of pipe x 22’ of pipe = 4.25’
10" pipe H = (16.05) / 1000' of pipe x 169' of pipe = 2.71’
14" pipe H = (3.12) / 1000' of pipe x 466' of pipe = 1.45’
H_{tot} @ 1,550 GPM = 4.25’ + 2.71’ + 1.45’ + 30.83 static = 39.24 feet

For Q = 4,470 GPM (Pump 101, Pump 102 & Pump 103 in Phase III):
6" pipe H = (179.65) / 1000' of pipe x 22' of pipe = 3.95'
10" pipe H = (14.92) / 1000' of pipe x 169' of pipe = 2.52'
14" pipe H = (2.90) / 1000' of pipe x 80' of pipe = 0.23' (Section 3)
14" pipe H = (10.46) / 1000' of pipe x 26' of pipe = 0.27' (Section 4)
14" pipe H = (22.17) / 1000' of pipe x 360' of pipe = 7.98' (Section 5)
H_{tot} @ 4,470 GPM = 3.95' + 2.52' + 0.23' + 0.27' + 7.98' + 30.83 static = 45.78 feet

3 pumps - Wemco Prerotation, Models F6K-L with 56 HP (based on motor size required for phase II), immersible motor operating at 1760 rpm

Aeration Basin:

The biological process will incorporate Bio-P, nitrification and denitrification through a series of anaerobic, anoxic and aerobic zones, which is estimated to remove 95% of ammonia and 80-90% of TN.

Raw influent will be mixed with recycle flows (tertiary filter and digestion) and RAS prior to entering the Stage 1 anaerobic basins. The anaerobic environment will ferment the MLSS and promote biological phosphorus removal. Effluent from the anaerobic basins will then enter the Stage 1 Anoxic Basins.

The Stage 1 Anoxic Basin will be design to promote denitrification. Nitrified MLSS will be returned from the Stage 1 Aerobic Basin to provide the nitrate to be removed. The BOD and VFA's from the Stage 1 Anaerobic Basin will provide the organic material to promote oxidation of the nitrate. The Stage 1 Anoxic Basins will be maintained at low dissolved oxygen (around 0.1 – 0.2 mg/L).

Effluent from the Stage 1 Anoxic Basins will be plug flow aerobic basins to complete the biological reduction and nitrification process. The Dissolved Oxygen in the Stage 1 Aerobic Basins will be maintain at 2 mg/L or greater and the diffusers will be arranged in a step aerations pattern to meet the demand of the mixed liquor. Effluent from the aerobic basins will be split between recycle flow (to the head of the Stage 1 Anoxic Basins) and the Stage 2 Anoxic Basins.

The Stage 2 Anoxic Basins will be maintained at low dissolved oxygen concentration. The design will include a complete mix basin with both diffusers and mechanical mixers to accomplish the required D.O. concentration. This stage is a polishing step. The remaining nitrogen gas will be released in the subsequent plug flow Stage 2 Aerobic Stage through vigorous aeration and agitation.

Basin Volume - Based on 24 hours detention

Each Train 96 x 32.5 x 15 = 46,800 cu. ft. or 350,000 gallons

Use 3 trains for a total of 1,050,000 gallons

Stage	Detention Time (Hours)	Length (Feet)	Volume (Gallons)
1st Stage Anaerobic Basins	2	8	29,172
1st Stage Anoxic Basins	4	16	58,344
1st Stage Aerobic Basins	14	56	204,204
2nd Stage Anoxic Basins	2.5	10	36,465
2nd Stage Aerobic Basins	1.5	6	21,879
Total	24	96	350,064

In accordance with Section 370.183.d the organic loading of the basins shall not exceed 15 lb. / 1,000 cu. ft.

Volume = (350,064 Gallons/ 7.48 gallons / cu. ft. *3 trains = 140,400 cu. ft.

Organic Loading = 2,102 lb. BOD5/day / (140,400 cu. ft.) = 15 lb. BOD5 /1,000 cu. ft.

Calculate Hydraulic Detention Time

Actual HDT = (1,050,192 gal x 24 hrs. / day) / (1,050,000 gal/day) = 24.00 hrs.

Waste Characteristics:

Design Average Flow =	1.05 MGD	
Peak Hourly Flow =	3.44 MGD	
Influent BOD_5 =	2,102 lbs. / day	240 mg/L
Influent rbCOD =	1,051 lbs. / day	120 mg/L
Influent TSS =	2,277 lbs. / day	260 mg/L
Influent NH_3-N =	219 lbs. / day	25 mg/L
Influent TKN =	328 lbs. / day	38 mg/L
Influent P =	53 lbs. / day	6 mg/L
Return Activated Sludge NO_3	16 lbs. / day	3 mg/L

Determine COD available for Phosphorus Removal

Denitrification of RAS NO_3-N

16 lbs. NO_3-N x 6.6 lbs. COD/lb. NO_3-N = 106 lbs. of COD

1,051 lbs. rbCOD – 106 lbs. COD = 945 lbs. of rbCOD available for P removal

Determine Phosphorus Removal due to rbCOD – Assume 10 lbs. rbCOD / lb. of P removed

53 lbs. of P removed * 10 lbs. rbCOD / lb. of P = 530 lbs. rbCOD required

945 lbs. of rbCOD available – 530 lbs. rbCOD Required = 415 lbs. of rbCOD remaining

Determine Parameters of $FeCl_3$ and PO_4

Molecular Weight of PO_4 = 95 g/mole

Moles / Pound of PO_4 = 453 g/lb. / 95 g/mole = 4.768 moles of PO_4 / pound

Molecular Weight of $FeCl_3$ = 164 g /mole

Moles / Pound of $FeCl_3$ = 453 g/lb. / 164 g/mole = 2.78 moles of $FeCl_3$ / pound

Weight of $FeCl_3$ per gal of solution = 11.23 lb. /gal x 35% = 3.93 lb. of $FeCl_3$ / gal

3.93 lb. of $FeCl_3$ / gal x 2.78 moles / pound = 10.9 moles of $FeCl_3$ per gallon

Determine $FeCl_3$ dosage for Secondary Treatment (use 3 moles $FeCl_3$ / per mole PO_4)

3 mol $FeCl_3$ per mole of PO_4 x 4.768 mol PO_4 / lb. PO_4 = 14.304 mol $FeCl_3$ /lb. PO_4

14.304 mol $FeCl_3$ / lb. PO_4 / 10.9 mol FeCl3 / gal $FeCl_3$ = 1.31 gals $FeCl_3$ / lb. PO_4

Use 1.5 gallons of $FeCl_3$ per pound PO_4

Determine Required Volume of $FeCl_3$

At a DAF of 1.05 MGD,

6 mg/L x 1.05 MGD x 8.34 = 52.5 lbs. PO_4 /day

1.5 gallons $FeCl_3$ /lb. PO_4 x 52.5 lbs. PO_4 /day = 78.8 gallons $FeCl_3$ /day

Determine Required Dosage Rate of $FeCl_3$

(78.8 gallons $FeCl_3$ /day x 11.23 lbs. /gal) x 35% = 310 lbs. $FeCl_3$ /day

310 lbs. / (8.34 lbs. /gal x 1.05 MGD) = 35.4 mg/l

Design includes two 5,000 gallon ferric chloride storage tanks and feed system for chemical polishing, which will provide almost 130 days storage.

Calculate Mean Cell Residence Time Θ_c for complete nitrification based on an MLSS concentration of 3,000 mg/l:

Calculate Internal Recycle Ratio

Q_{IR}= (NH -N_{in} / NO_3-N_{out}) – 1 *(Assume 80% TKN Removal)*
Q_{IR} = (25 mg/l/ (25 x 0.2)) – 1 = 4

Therefore the recycle rate in the first stage anoxic zone must be 1.05 x 4 = 4.2 MGD for 80% denitrification. Note: 3 trains therefore 1.4 MGD per train

Calculate specific growth rate μ' adjusted for temp, D.O. and pH

$\mu'_m = \mu_m e^{0.098(T-15)}$ x DO/(K_{o2}+DO) x (1 – 0.833(7.2-pH)
μ_m = maximum specific growth rate, 0.5 d^{-1}
T = temperature 10° C
DO = Dissolved Oxygen, 2.0
K_{O2} = DO half velocity constant, 1.3
pH = 7.2

μ'_m = [0.5 x $e^{0.098(10-15)}$]x [2/(1.3+2)] x [(1 – 0.833(7.2-7.2)]
μ'_m = [0.5 x $e^{-0.49}$] x [0.606] x [1]
μ'_m = [0.306] x [0.606] x [1]
μ'_m = 0.19 d^{-1}

Calculate the required maximum rate of substrate utilization

k' = μ'_m / Y where:
Y = Yield coefficient (Nit/denit.) = 0.2 lb. VSS/lb. NH_4-N
k_d = endogenous decay rate coefficient = 0.05 d^{-1}
k' = maximum rate of substrate utilization
k' = 0.19 d^{-1}/ 0.2 = 0.93 d^{-1}

Calculate minimum Mean Cell Residence Time, Θ^M_c for nitrification/ denitrification
$1/\Theta_c$ = Yk' – k_d where:
Θ_c = mean cell residence time
Y = Yield coefficient (Nit/denit.) = 0.2 lb. VSS/lb. NH_4-N
k_d = endogenous decay rate coefficient = 0.05 d^{-1}
k' = maximum rate of substrate utilization = 0.93 d^{-1}

$1/\Theta^M_c$ = Yk' – k_d
$1/\Theta^M_c$ = (0.2 x 0.93 d^{-1}) – 0.05 d^{-1}
$1/\Theta^M_c$ = 0.14
Θ^M_c = 7.37 days

Use a safety factor of 2
Θ_c = 7.37 x 2 = 14.74 days

Calculate the design substrate utilization factor, U for oxidation of ammonia

$1/\Theta_c = YU_N - k_d$
$U_N = (1/\Theta_c + k_d) / Y$
$U_N = ((1/14.74\ d) + 0.05) / 0.2$
$U_N = 0.59\ d^{-1}$

Calculate the effluent ammonia concentration, N

$U_N = k'N / (K_N + N)$
U_N = Design substrate utilization rate, 0.59 d^{-1}
k' = maximum rate of substrate utilization, 0.93 d^{-1}
$K_N = 10^{(0.051T-1.158)} = 10^{((0.051x10)-1.158)} = 0.225$ mg/l

$0.59\ d^{-1} = (0.93 \times N) / (0.225 + N)$
$0.59\ d^{-1} \times (0.225 + N) = (0.93 \times N)$
$0.132 + 0.59N = 0.93N$
$0.132 = 0.34N$
$N = 0.391$ mg/L

Calculate the BOD_5 Removal Rate for the activated sludge process

$1/\Theta_c = YU - k_d$
Θ_c = 14.74 d (from previous calculation)
Y = Yield Coefficient for BOD_5 = 0.65 lb. VSS / lb. BOD_5
k_d = endogenous decay rate coefficient = 0.05 d^{-1}

$1/ 14.74 = (0.65\ lbs. / lbs. \times U) - 0.05$
$0.12 = 0.65U$
U = 0.18 lbs. BOD / lb. MLVSS

Calculate Hydraulic Detention Time

BOD_5 Reduction

$\Theta_{BOD} = (S_o - S) / UX$
U = 0.18 lbs. BOD / lb. MLVSS
S_o = Influent BOD_5 conc. = $2{,}102_{influentBOD} - 530_{P\ removal}$ = 1,572 lbs. BOD_5 or 179 mg/L
S = Effluent BOD_5 conc. = 0 mg/L
X = MLVSS Conc. (assume 78% volatile) = (3,000 x 78%) = 2,340 mg/L
Θ = (179 mg/L – 0 mg/L)/ (0.18 lbs. / lb. x 2,340 mg/L) = 0.42 d or 10.1 hrs.

Ammonia Reduction

$\Theta = (N_o - N) / U_N X f_n$
N_o = Influent Ammonia = 25 mg/L
N = Effluent Ammonia = 0.391 mg/L
U_N = Substrate utilization for ammonia = 0.59 d^{-1}
X = MLVSS Conc. (assume 78% volatile) = (3,000 x 78%) = 2,340 mg/L
f_n = fraction of MLVSS of nitrifying bacteria = 0.08
$\Theta = (25 - 0.391) / (0.52 \times 2{,}340 \times 0.08)$
Θ = 0.25 d or 6.1 hrs.

Calculate overall sludge age: Note – V_a = 0.42 based on 1st Stage Aerobic Basin alone, if 1st Stage Anoxic is included then V_a = 0.59

$\Theta_c' = \Theta_c / V_a$
V_a = Aerobic volume fraction = 0.42 (aerobic) or 0.59 (anoxic & aerobic)
Θ_c = required nitrification sludge age = 14.74 days
$\Theta_c' = \Theta_c / V_a = 14.74 / 0.42 = 35.1$ days
$\Theta_c' = \Theta_c / V_a = 14.74 / 0.59 = 25.0$ days
Projected Θ_c' = (1.05 x 3,000 x 8.34)/ (2,102 lb BOD_5 *.65 yield) = 19.2 days

Calculate the degradable fraction of the MLVSS, f_{vss}

$f_{vss} = (f'_{vss}) / [1 + (1 - f'_{vss})k_d\Theta'_c]$

Where:
f'_{vss} = degradable fraction of VSS at generation = 0.8
k_d = endogenous decay rate = 0.05
Θ'_c = overall sludge age = 19.2 days

$f_{vss} = (0.8) / [1 + (1 - 0.8) \times 0.05 \times 19.2]$
$f_{vss} = 0.67$

Calculate the total aerobic detention time, Θ_a

$\Theta_a = [\Theta'_c Y_h(S_o - S)] / [X_a (1 + k_d f_{vss}\Theta'_c)]$

where:
Θ'_c = overall sludge age = 19.3 days
Y_h = hetrotrophic yield coefficient = 0.55
S_o = Influent BOD_5 = 179 mg/L
S = Effluent BOD_5 = 0 mg/L
X_a = MLVSS, 2,340 mg/L
k_d = endogenous decay rate = 0.05

f_{vss} = 0.67

Θ_a = [19.3 x 0.55 x (179)] / [2,340 x (1 + (0.05 x 0.67 x 19.2)]
Θ_a = 0.49 days or 11.8 hours

Calculate the rate of denitrification for 10° C, U'_{DN}

$U'_{DN} = U_{DN} \times 1.09^{(T-20)} \times (1-DO)$
Where:
$U_{DN} = 0.10\ d^{-1}$
$T = 10^o$ C
DO = 0.1 mg/L

$U'_{DN} = 0.10 \times 1.09^{(10-20)} \times (1-0.1)$
$U'_{DN} = 0.10 \times 1.09^{(10-20)} \times (1-0.1)$
$U'_{DN} = 0.038$

Calculate the anoxic residence for denitrification, Θ_{DN}

$\Theta_{DN} = (N_o - N) / [U_{DN} \times X_a]$
where:
U_{DN} has a range of 0.038
N_o = 25 mg/L
N = 10% of N_o or 2.5 mg/L
X_a = 2,340 mg/L MLVSS
Θ_{DN} = (25 – 2.5)/ [0.038 x 2,340]
Θ_{DN} = 0.25 days or 6.1 hours

6 hours are provided in 1st stage
<u>Note: Methanol feed required in 2nd stage.</u>

Recommended Unit Process Sizing:

First Stage Anaerobic Zone = 2.5 hours

1.05 MGD x 2.5 hrs. / (24 hr./day) = 109,000 gallons
109,000 gallons / 3 basins = 36,333 gallons per train
36,333 gal/basin / 7.48 cu. ft./gal = 4,857 cu. ft.
Dimensions assuming 15 feet SWD
4,857 CF / 15 feet/ 32.5 wide = 10 feet long

First Stage Anoxic Zone = 6 hours

1.05 MGD x 6 hrs./24 hr./day = 262,500 gallons
262,500 gallons / 3 basins = 87,500 gallons per train
87,500 gal/basin / 7.48 cu. ft. /gal = 11,698 cu. ft.
Dimensions assuming 15 feet SWD
11,698 CF / 15 feet/ 32.5 wide = 24 feet long

First Stage Aerobic Zone = 12 hours

1.05 MGD x 12 hrs./24 hr./day = 525,000 gallons
525,000 gallons / 3 basins = 175,000 gallons per train
175,000 gal/basin / 7.48 cu. ft. /gal = 23,396 cu. ft.
Dimensions assuming 15 feet SWD
23,396 CF / 15 feet/ 32.5 wide = 48 feet long

Second Stage Anoxic Zone = 2.5 hours

1.05 MGD x 2.5 hrs./24 hr./day = 109,375 gallons
109,375 gallons / 3 basins = 36,458 gallons per train
36,458 gal/basin / 7.48 cu. ft. /gal = 4,874 cu. ft.
Dimensions assuming 15 feet SWD
4,874 CF / 15 feet/ 32.5 wide = 10 feet long

Second Stage Aerobic Zone = 1 hour

1.05 MGD x 1 hrs./24 hr./day = 43,750 gallons
43,750 gallons / 3 basins = 14,593 gallons per train
14,593 gal/basin / 7.48 cu. ft. /gal = 1,950 cu. ft.
Dimensions assuming 15 feet SWD
1,950 CF / 15 feet/ 32.5 wide = 4 feet long

Prove Sludge Age is Sufficient

Calculate overall sludge age: Note – V_a = 0.50 based on 1st Stage Aerobic Basin alone, if 1st Stage Anoxic is included then V_a = 0.75

$\Theta_c' = \Theta_c / V_a$
V_a = Aerobic volume fraction = 0.50 (aerobic) or 0.75 (anoxic & aerobic)
Θ_c = required nitrification sludge age = 14.74 days
$\Theta_c' = \Theta_c / V_a = 14.74 / 0.50 = 29.5$ *days*
$\Theta_c' = \Theta_c / V_a = 14.74 / 0.75 = 19.6$ *days*
*Projected Θ_c' = (1.05 x 3,000 x 8.34)/ (2,102 lb BOD_5 *.65 yield) = 19.2 days - check*

1st Stage Anoxic Zone

Suspended Growth System Loading Rate

Influent BOD_5 = 2,102 lb./day
rbCOD used for RAS NO_3 = 106 lbs./day
rbCOD used for Phosphorus = 530 lbs./day
COD Loading = 2,102 lbs. BOD_5 /day – (106 + 530) lbs. COD/day = 1,466 lbs. bCOD/ day

Calculate BOD required for Denitrification
Ammonia Converted = 219 lbs. NO_3-N/day
Recycle Flow at 4Q = 80%
Nitrate load = 80% x 219 lbs. NO_3-N /day = 175 lbs. NO_3-N /day
Convert 175 lbs. of Nitrate, conversion uses 6.6 lbs. $bCOD_5$ / lb. NO_3^-
175 lbs. NO_3-N x 6.6 lbs. bCOD/lb. NO_3-N = 1,156 lbs. of bCOD
1,466 lbs. COD – 1,156 lbs. bCOD = 310 lbs. of bCOD extra
System capable of 80% nitrate reduction

Calculate the Aeration **Blowers** required in the First Stage Anoxic Basins

BOD_5 Remaining @ DAF = 310 lbs. of bCOD
BOD_5 Remaining @ PHF = 310 lbs. of bCOD * 3.27 peak = 1,014 lbs. bCOD

O_2 required for BOD_5 = (1.0 x 1,014) = 1,014 lbs. of O_2 Required

AOR = 1,014 lb. of O_2/day ÷ 24 hrs./day = 42 lb. O_2/hr. Max.

T = Temperature (°C) = 20 °C (Summer)

Summer AOR/SOR

$$AOR/SOR = (\alpha ((\beta \times C_{20} (C_{smt}/C_s) (P_{site}/P_{sc})) - C_w)) \theta^{(T-20)}) / C_{20}$$
$$AOR/SOR = 0.40 ((0.95 \times 10.61 (9.09/9.09) (14.37/14.70)) – 0.1)) 1.024^{(20-20)} / 10.61$$
$$AOR/SOR = 0.40 (9.75) 1.024^{(20-20)} / 10.61$$

$$AOR /SOR = 0.368$$

Pounds of Oxygen per Hour per Unit, SOR

Air Supply per Disc = 3.65 scfm/sf x 0.41 sf/ diffuser = 1.5 scfm / disc

1.5 scfm/disc x 60 min/hr. x 0.075 lb. air / cu. ft. air x 0.232 lb. O_2 / lb. air = 1.566 lb. O_2/ disc/ hr.
1.566 lb. x 21 % OTE @ 5 years = 0.329 lb. O_2

Number of Diffusers Required

42 lbs. /hr. / (0.329 x 0.368) = 347 Diffusers

Air Requirements for Oxygenation @ PHF

1.5 scfm/diffuser x 347 diffusers = 520 scfm

Air Requirements for Oxygenation @ DAF

520 scfm / 3.27 Peak = 159 scfm

Number of Blowers = 2 (one as spare)

Capacity of Each Blower = 526 scfm at 7.0 PSI (based n PHF)

Therefore 2 blowers at 100% at PHF & 1 blower at 60% at DAF

Calculate Mixing Requirement:

3 basins x 32.5 ft. x 15 ft. x 0.12 scfm/sq. ft. = 176 scfm for mixing

Basins are mixing limited.

<u>1st Stage Aerobic Zone</u>

Calculate the Aeration required in the First Stage Aerobic Basins

O_2 required for BOD_5 = 2,102 lbs. (influent) – ½ 530 lbs. (P) – ½ (1,156 + 106) lbs. (TN) = 1,206 lbs. of O_2 Required

O_2 required for nitrification = 4.6 lbs. O_2 / lb. NH_s x 219 lbs. NH_3 = 1,007 lbs. of O_2

Aeration requirement = 1,206 lbs. + 1,007 lbs. = 2,213 lbs. O_2/day

AOR = 2,213 lbs. O_2/day ÷ 24 hrs./day = 92.2 lbs. O_2/hr.

Oxygen Transfer Efficiency (Clean Water) = 21% at depth of 15 ft.

Csmt =Surface Saturation (Summer) = 9.09 mg/L

C_{20} = Saturation at 40% of total depth = 10.61 mg/L

Cs = 9.09 mg/L (as per diffuser manufacturer)

Cw = Dissolved Oxygen Maintained in Tank = 2.0 mg/L (as per IEPA)

θ = Constant = 1.024

T = Temperature (°C) = 20 °C (Summer)

Summer AOR/SOR

$$AOR/SOR = (\alpha ((\beta \times C_{20} (C_{smt}/C_s) (P_{site}/P_{sc})) - C_w)) \theta^{(T-20)}) / C_{20}$$

$$AOR/SOR = 0.55 ((0.95 \times 10.61 (9.09/9.09) (14.37/14.70)) – 2.0)) 1.024^{(20-20)} / 10.61$$
$$AOR/SOR = 0.55 (7.85) 1.024^{(20-20)} / 10.61$$

$$AOR /SOR = 0.407$$

Pounds of Oxygen per Hour per Unit, SOR

Air Supply per Disc = 1.5 scfm (per diffuser manufacturer)

1.5 scfm x 60 min/hr. x 0.075 lb. air / cu. ft. air x 0.232 lb. O_2 / lb. air = 1.566 lbs. O_2
1.566 lbs. x 21 % OTE = 0.33 lb. O_2/Disc/hr.

Number of Diffusers Required @ DAF

92.2 lbs. /hr. / (0.33 x 0.407) = 686 Diffusers @ DAF
(92.2 lbs. /hr. x 3.27 peak)/ (0.33 x 0.407) = 2,245 diffusers @ PHF

Air Requirements for Oxygenation @ DAF

1.5 scfm/diffuser x 686 diffusers = 1,029 scfm @ DAF
1,029 scfm @ DAF x 3.27 Peak = 3,365 scfm @ PHF

Calculate Mixing Requirement:

3 basins x 32.5 ft. x 56 ft. x 0.12 scfm/sq. ft. = 655 scfm for mixing

Basins are not mixing limited

<u>2nd Stage Anoxic Zone</u>

Mixing required for second stage Anoxic Zone supplied by mechanical mixers

Methanol Addition

Residual Concentration of Methanol as bCOD

MLSS = 3,000 mg/L
SRT = 5 days for second stage anoxic zone (*minimum per M&E 2003, page 785*)
Y = Synthesis Yield = 0.17 lb. VSS / lb. bCOD
k_d = Endogenous Decay = 0.04 d^{-1}
μ_m = Maximum Specific Growth Rate, 0.52 d^{-1}
k = Maximum Specific Substrate Utilization Rate = 3.1 lb. bCOD / lb. VSS / day
K_s = Half-Velocity = 12.6 mg/L
(Constants at 10°C per M&E 2003, Table 8-20)

S = Residual Methanol Concentration as bCOD, mg/L
$S = (K_s \times (1 + k_d \times SRT)) / [SRT \times ((Y \times k) - k_d) - 1]$
$S = (12.6 \times (1 + 0.04 \times 5)) / [5 \times ((0.17 \times 3.1) - 0.04) - 1] = 10.5$ mg/L bCOD

Required Methanol Dose, S_o

Influent NO_3-N = 5 mg/L NO_3-N
Y_n = Net Biomass Yield = $Y / (1 + k_d \times SRT)$
= (0.17 lbs. VSS / lb. bCOD) / (1 + 0.04 d^{-1} x 5 d) = 0.142 lbs. VSS / lb. NO_3-N
Ratio = (2.86 lbs. O_2/lb. NO_3-N) / (1 – (1.42 lbs. O_2/lb. VSS) x Y_n)
= 3.6 lbs./lb. NO_3-N
Dose as COD = (Ratio) x (NO_3-N to be reduced) + S
= (3.6 lbs./lb. NO_3-N) x (5 – 3 mg/L NO_3-N)+(10.5 mg/L bCOD) = 17.7 mg/L COD
Dose as Methanol = (17.7 mg/L COD)/(1.5 lbs. COD/lb. CH_3OH)
= 11.8 mg/L CH_3OH = 103 lbs./day CH_3OH = 37,716 lbs./year CH_3OH

<u>2nd Stage Aerobic Zone</u>

Calculate oxygen requirement assuming worst case 20% bleed through of BOD_5

O_2 required for BOD_5 = (20% x 2,102) = 525 lbs. of O_2 Required

AOR = 525 lb. O_2/day ÷ 24 hrs./day = 22 lb. O_2/hr.

Oxygen Transfer Efficiency (Clean Water) = 21% at depth of 15 ft.

Csmt =Surface Saturation (Summer) = 9.09 mg/L

C_{20} = Saturation at 40% of total depth = 10.61 mg/L

Cs = 9.09 mg/L (as per diffuser manufacturer)

Cw = Dissolved Oxygen Maintained in Tank = 0.1 mg/L (as per IEPA)

θ = Constant = 1.024

T = Temperature (°C) = 20 °C (Summer)

Summer AOR/SOR

$$AOR/SOR = (\alpha ((\beta \times C_{20} (C_{smt}/C_s) (P_{site}/P_{sc})) - C_w)) \theta^{(T-20)}) / C_{20}$$
$$AOR/SOR = 0.65 ((0.95 \times 10.61 (9.09/9.09) (14.37/14.70)) – 0.1)) 1.024^{(20-20)} / 10.61$$
$$AOR/SOR = 0.65 (9.75) 1.024^{(20-20)} / 10.61$$

$$AOR /SOR = 0.61$$

Pounds of Oxygen per Hour per Unit, SOR

Oxygen Transfer Efficiency (Clean Water) = 21% at depth of 15 ft

Air Supply per Tube = 1.5 scfm (per diffuser manufacturer)

1.5 scfm x 60 min/hr. x 0.075 lb. air / cu. ft. air x 0.232 lb. O_2 / lb. air = 1.566 lb. O_2
1.566 lb. x 21 % OTE = 0.329 lb. O_2

Number of Diffusers Required

22 lbs. /hr. / (0.329 x 0.61) = 110 Diffusers

Air Requirements for Oxygenation

1.5 scfm/diffuser x 110 diffusers = 164 scfm

3 basins x 32.5 ft. x 10 ft. x 0.12 scfm/ sq. ft. = 117 scfm for oxygenation

Mixing required for 2nd Stage Aerobic Zone provided by aeration

Calculate mixing requirement

3 basins x 32.5 ft. x 6 ft. x 0.12 scfm/ sq. ft. = 70 scfm for mixing

Basin	SOTR	# Diffusers	Air @ DAF	Air @ PHF
1st Stage Aerobic =		686 Diffusers	1,029 scfm	3,365 scfm
2nd Stage Anoxic =		111 Diffusers	164 scfm	536 scfm
2nd Stage Aerobic =		45 Diffusers	70 scfm	70 scfm
Centrifugal Blowers		900 Diffusers	1,350 scfm	4,255 scfm

3 Existing Blowers are 1,800 @ 6.92 psi (Double check in final design) each

Use 4 Blowers (1 as spare) =

3 Blowers Operating at 100% = 5,400 scfm > 4,255 scfm required

Volume of Return Activated Sludge (RAS)

DAF = 1.05 & Assume RAS concentration is 7,500 mg/L
$(Q_{RAS} \text{ x mg/L}_{RAS}) + (Q_{in} \text{ x mg/L}_{in\ BOD}) = (Q_{in\ BOD} + Q_{RAS}) \text{ x mg/L}_{MLSS}$
$(Q_{RAS} \text{ x } 7{,}500 \text{ mg/L}) + (1.05 \text{ x } 240 \text{ mg/L}) = (1.05 + Q_{RAS}) \text{ x } 3{,}000 \text{ mg/L}$
$7{,}500Q_{RAS} + 252 = 3{,}150 + 3{,}000\ Q_{RAS}$
$4{,}500\ Q_{RAS} = 2{,}898$
$Q_{RAS} = 0.64$ MGD

PWWF = 3.44 & Assume RAS concentration is 7,500 mg/L
$(Q_{RAS} \text{ x mg/L}_{RAS}) + (Q_{in} \text{ x mg/L}_{in\ BOD}) = (Q_{in\ BOD} + Q_{RAS}) \text{ x mg/L}_{MLSS}$
$(Q_{RAS} \text{ x } 7{,}500 \text{ mg/L}) + (3.44 \text{ x } 240 \text{ mg/L}) = (3.44 + Q_{RAS}) \text{ x } 3{,}000 \text{ mg/L}$
$7{,}500Q_{RAS} + 826 = 10{,}320 + 3{,}000\ Q_{RAS}$
$4{,}500\ Q_{RAS} = 9{,}494$
$Q_{RAS} = 2.11$ MGD

Waste Activated Sludge

The estimated Yield from the Bio-P process is 0.80 pound of solids per pound of BOD applied

WAS Production = 0.80 lb./lb. x 2,102 lbs. BOD_5 / day = 1,682 lbs./day

Volume Produced = 1,682 lbs./day ÷ (0.0075 lb. WAS/lb. Soln x 8.34) = 26,884 gpd

MCRT based on BOD_5

Influent BOD_5 = 2,102 lbs.
MLSS = 3,000 mg/L
Total solids under aeration:
1.05 MG x 3,000 mg/L x 8.34 = 26,271 lbs. under aeration
MCRT = 26,271 lbs. solids under aeration / 2,102 lbs. BOD_5/day = 12.5 days

Sludge Age based on WAS

MLSS = 3,000 mg/L
Total Volume = 327,472 cu. ft. = 2,450,000 gallons
Total solids under aeration:
1.05 MG x 3,000 mg/L x 8.34 = 26,271 lbs. under aeration
WAS = 1,682 lbs. per day
Sludge Age = 26,271 lbs. solids under aeration / 1,682 lbs. BOD_5/day = 15.6 days

F/M Ratio

Calculate F/M ratio = influent lbs. BOD_5/day / total lbs. solids under aeration
Influent BOD_5 = 2,102 lbs.
MLSS = 3,000 mg/L
Total Volume = 1,050,000 gallons
Total solids under aeration:
1.05 MG x 3,000 mg/L x 8.34 = 26,271 lbs. under aeration
F/M = 2,102 lbs. BOD_5/day / 26,271 lbs. under aeration = 0.08

Mixed Liquor Diversion Structure

The mixed liquor diversion structure splits the flow from the aeration basins to the clarifiers. The diversion structure is designed to handle the Phase III DAF and PHF.

Number of Units 1 Proposed
DAF + RAS + Tertiary Filter Return (TFR) =1.05 + 0.64 + 0.18 = 1.87 MGD
PHF+ RAS + TFR = 3.08 + 2.11 + 0.18 =5.37 MGD
PWWF + RAS+ TFR = 4.10 + 2.11 + 0.18 = 6.39 MGD

Final Clarifiers

There are two existing center feed final clarifiers of the hydraulic differential design with suction sludge and scum removal. The clarifiers are to be protected by aluminum covers in order to prevent icing which could be the result of extremely long detention times in the aeration basins. The process design calculations are shown below.

Calculate Surface Loading Rate (4.46 PWWF)

Surface loading rate shall not exceed 1,000 gpm/ sq. ft. /day at PWWF
Proposed Surface Loading Rate = 4,460,000 gal/day / (2,827 sq. ft. x 2) = 789 gal/day/ sq. ft.

Calculate Solids Loading Rate

Solids loading shall not exceed 50 lb. /day/ sq. ft.
Total MLSS lbs./day = 3,000 mg/L x (4.46 MGD + 2.11 MGD) x 8.34 lbs./gal = 164,381 lbs./day
Solids loading rate = 164,381 lbs./day / (2,827 sq. ft. x 2) = 29.07 lbs./day/ sq. ft.

Calculate Weir Loading Rate

Weir overflow rate shall not exceed 30,000 gal/day/ft. at Peak Hourly Flow Rate
Actual overflow rate = 4,460,000 gal/day / (346 lin. ft. x 2) = 6,445 gal/day/ft.

Tertiary Filters

The Phase III design includes 16 tertiary filter cells. The system will be designed for a peak wet weather flow rate of less than 5 gallons per minute per square foot at the hydraulic loading rate of the Phase IV design (5.2 MGD).

Calculate Filter Surface Area

The Illinois Administrative Code requires a surface loading rate not to exceed 5 gpm per square foot. The Phase III Peak Wet Weather Flow Rate + Tertiary Filter Return is 4.46 MGD or 3,097 gpm. The Phase IV Peak Wet Weather Flow Rate + Tertiary Filter Return is 5.2 MGD or 3,680 gpm. The design includes 16 cells at 50 square feet per cell.

Calculate Phase III loading:

50 sq. ft. / cell x 15 cells = 750 sq. ft. (total)
15 units operating in Phase III
3,097 gpm / 750 sq. ft. = 4.1 gpm / sq. ft.

Calculate Phase IV loading:

50 sq. ft. / cell x 15 cells = 750 sq. ft. (total)
15 units operating in Phase IV
3,680 gpm / 750 sq. ft. = 4.9 gpm / sq. ft.

Calculate Backwash rate with all cells in service:

8 gpm / cell x 16 cells = 128 gpm (total) = 0.18 MGD

Calculate Air Rate with all cells in service:

3 cfm / cell x 16 cells = 48 cfm (total)

Reaeration Basin

Calculate oxygen requirement to increase D.O. to 7 mg/L:

AOR = 5.2 MGD x 7.0 mg/L x 8.34 lbs./gal = 304 lbs. / day
AOR = 304 lbs. O_2/day ÷ 24 hrs./day = 13 lbs. O_2/hr.

Oxygen Transfer Efficiency (Clean Water) = 21% at depth of 15 ft.

Csmt =Surface Saturation (Summer) = 9.09 mg/L

C_{20} = Saturation at 40% of total depth = 10.61 mg/L

Cs = 9.09 mg/L (as per diffuser manufacturer)

Cw = Dissolved Oxygen Maintained in Tank = 7.0 mg/L

θ = Constant = 1.024

T = Temperature (°C) = 20 °C (Summer)

Summer AOR/SOR

$$AOR/SOR = (\alpha\ (\ (\beta \times C_{20}\ (C_{smt}/C_s)\ (P_{site}/P_{sc})\ )\ -\ C_w)\ )\ \theta^{(T-20)})\ /\ C_{20}$$

$$AOR/SOR = 0.9\ (\ (0.95 \times 10.61\ (9.09/9.09)\ (14.37/14.70)\ ) - 7.0)\ )\ 1.024^{(20-20)}\ /\ 10.61$$
$$AOR/SOR = 0.90\ (2.85)\ 1.024^{(20-20)}\ /\ 10.61$$

$$AOR\ /SOR = 0.24$$

Pounds of Oxygen per Hour per Unit, SOR

Oxygen Transfer Efficiency (Clean Water) = 21% at depth of 15 ft.

Air Supply per Tube = 1.5 scfm (per diffuser manufacturer)

1.5 scfm x 60 min/hr. x 0.075 lb. air / cu. ft. air x 0.232 lb. O_2 / lb. air = 1.566 lbs. O_2
1.566 lbs. x 21 % OTE = 0.329 lb. O_2

Number of Diffusers Required

13 lbs. / hr. / (0.329 x 0.24) = 164 Diffusers

Air Requirements for Oxygenation

1.5 scfm/diffuser x 164 diffusers = 246 scfm

Diffuser density 10% coverage or 5 sq. ft. / diffuser

5 sq. ft. / diffuser & 164 diffusers = 820 sq. ft.
820 sq. ft. x 14 ft. SWD = 11,480 cu. ft. or 12,000 cu. ft.

Ultraviolet Disinfection

The ultraviolet disinfection is designed around proven technology and will provide disinfection for 5.20 MGD at 10 mg/L TSS at 65% transmittance through high intensity ultraviolet radiation. The Phase III facility design Peak Wet Weather Flow is 4.10 MGD.

RAS/WAS Pump Station

The RAS/WAS Pump Station will use the pre-rotation concept to accommodate for variable flow conditions. The pump station is designed as a four pump station with three pumps existing. The fourth pump will be installed in this phase. The original design allowed for construction of a second 8" force main that will be required during this phase (confirm during design phase). The WAS flow will be conveyed to the aerobic digesters through a 6" force main which is connected to the RAS force main. The flow rate as well as wasting cycles will be controlled via an automated pinch valve.

Headloss Calculations for RAS/WAS Force Main:

Hazen-Williams formula:

$$H = \left(\frac{147.85 \times Q_{gpm}}{C \times d_{in}^{2.63}}\right)^{1.852}$$

Where:

H = Headloss (ft. H_2O per 1,000 feet of pipe)
Q = Flow (gpm)
C = 110
d = Diameter (inches)

Pump to header of RAS Force Main, from RAS/WAS Lift Station to RAS/WAS split

8" Header Elevation (ft.) =	735.83
Basin Inlet (ft.) =	730.63
Static Head (ft.) =	5.20

6" Force Main @ 500 gpm 1/3 of (1,473 gpm RAS + 17.5 gpm WAS)

1 - 6" Long 90 Elbow	8' of 6" pipe
1 - 6" 90 Elbow	16' of 6" pipe
1 - 6" Check Valve	40' of 6" pipe
1 - 6" Plug Valve	4' of 6" pipe
6" Force Main	5' of 6" pipe
	73' of 6" pipe

Use Hazen-Williams formula, where:

H = Head loss per 1,000 feet of pipe
C = 120
D = 6 inches
Q = Flow in gpm
H = 5.67 / 1,000 ft. or 6 ft. / 1,000 ft.

2-8" Forcemain @ 750 gpm (1,473 gpm RAS + 17.5 gpm WAS)/2

3 - 8" Run of Tee	45' of 8" pipe
1 –Tee - Side Out	45' of 8" pipe
1 - 45° Bends	14' of 8" pipe
8" Forcemain	34' of 8" pipe
	138' of 8" pipe

Use Hazen-Williams formula, where:

H = Head loss per 1,000 feet of pipe
C = 120
D = 8 inches
Q = Flow in gpm
H = 12.41 / 1,000 ft. or 13 ft. / 1,000 ft.

Static Head =	5.20
Friction Loss 6" = 73 ft. x 6 ft./ 1,000 ft.	0.44
Friction Loss 8" = 138 ft. x 13 ft. / 1,000 ft.	1.80
Total Dynamic Head (1) =	7.44

From RAS/WAS Split to Headworks

MWL in Screen Channel=	740.70
8" Header Elevation (ft.) =	735.83
Static Head (ft.) =	4.87

8" Force Main @ 750 gpm (100% RAS)

1 - 45° Bends	14' of 8" pipe	
5 - Standard Elbows		100' of 8" pipe
1- 8" Run of Tee	15' of 8" pipe	
1 - 8" Plug Valve	5' of 8" pipe	
8" Force Main	375' of 8" pipe	
		509' of 8" pipe

Static Head =	4.87
Friction Loss 8" 509 ft x 13 ft / 1,000	6.62
Total Dynamic Head (2) =	11.49

Combined TDH (RAS/WAS Lift Station to Headworks) @ 100% RAS = 500 gpm

Total Dynamic Head (1) =	7.74
Total Dynamic Head (2) =	11.49
Total Dynamic Head (3) =	19.23

Sludge Handling – Aerobic Digestion – Converted from original package plant in Phase II

Aerobic Digestion Volume Provided

Side Water Depth = 15 (ft.)

Digester 801 = 654(sq. ft.) x 15 ft. =	9,810 cubic feet
Digester 802 = 1,145 (sq. ft.) x 15 ft. =	17,175 cubic feet
Digester 803 = 1,097 (sq. ft.) x 15 ft. =	16,455 cubic feet
Total	43,440 cubic feet

Calculate sludge volume

1.05 x 240 mg/L x 8.34 lbs. gal x 0.80 production = 1,681 lbs. of WAS
1,681 lbs. of WAS / (8.34 lbs. / gal X 25,000 mg/L) = 8,064 gal/day = 1,078 cu. ft. / day

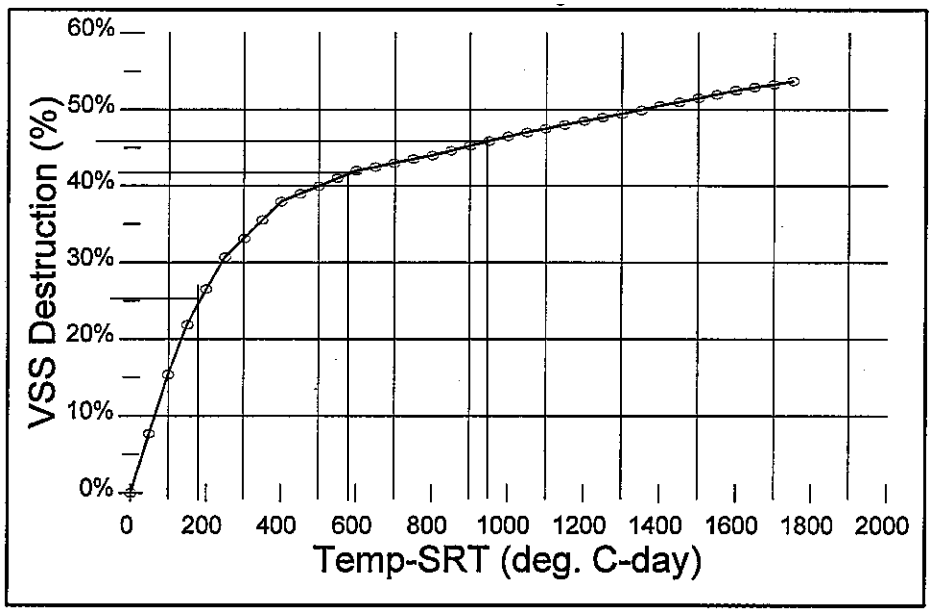
Calculate detention time

43,440 cu. ft. / (1,078 cu. ft. WAS / day) = 40 days

Volatile Suspended Solids = 1,681 lbs. WAS/day x 78% Volatile = 1,311 lbs. VSS/day

Fixed Solids = 1,681 lbs. WAS/day – 1,311 lbs. VSS/ day = 370 lbs. Fixed/day

Figure 6-1 | Digester VSS Destruction vs. Temperature-Time Curve



The digesters are divided into three stages with a gravity thickener working in combination with Stage #1 to maintain 2.5% solids.

Digester Stage #1 Aeration Requirements & VSS Reduction

Calculate Stage #1 Detention Time, assuming 2.5% solids

(1,681 lbs. WAS/day) / (2.5% x 8.34 lbs. / gal) = 8,064 gal/day = 1,078 cu. ft. / day

9,810 cu. ft. / (1,078 cu. ft. /day) = 9.1 days

Calculate Stage #1 VSS concentration

1,681 x 78% Volatile = 1,311 lbs. VSS/ day

1,681 – 1,311 = 370 lbs. fixed

Calculate Stage #1 Air Requirement @ 20 ^{o}C

Digester Temperature = 20 ^{o}C
Detention Time = 9 days
VSS Reduction = 9 days @ 20 ^{o}C = 180 days-^{o}C
VSS Reduction Percentage = 180 days-^{o}C = 25% Reduction (from Figure 6-1)
VSS Reduction in 1st Stage= 1,311 lbs. VSS/ day x 25% = 328 lbs. VSS/day

Calculate Stage #1 Process Oxygen Required

AOR = (328 lbs. VSS/ day) x (2.0 lbs. O_2/ lb. VSS destroyed) = 656 lbs. O_2/ day
AOR/SOR = 0.3 (*estimated, must be confirmed during design)*
SOR = (656 lbs. O_2/ day) / 0.3 = 2,187 lbs. O_2/ day or 1.52 lbs. O_2/ min.
Diffuser Submergence = 14.5 ft.
OTE = 8% (per diffuser manufacturer)
Calculate Air Flow Rate
1.52 lbs. O_2/ min. / (0.075 lbs. / cu. ft. x 23.2% O_2 x 8% OTE) = 1,091 scfm

Calculate Stage #1 Air Required for Mixing

1,010 cu. ft. x 30 scfm / 1,000 cu. ft. = 303 scfm – *Biological requirements govern*

Digester Stage #2 Aeration Requirements & VSS Reduction

Calculate Stage #2 Detention Time, assuming 2.5% solids

1,681 lbs. WAS – 328 lbs. VSS destroyed = 1,353 lbs. remaining

1,353 lbs. / (2.5% x 8.34 lbs. / gal x 7.48 gal / cu. ft.) = 867 cu. ft. feet transferred

17,175 cu. ft. / (867 cu. ft. / day) = 20 days

Calculate Stage #2 VSS concentration

1,311 lbs. VSS – 328 lbs. VSS destroyed in Stage 1 = 983 lbs. VSS / day

Calculate Stage #2 Air Requirement @ 20 ^{o}C

Digester Temperature = 20 ^{o}C
Detention Time = 9 + 20 days = 29
VSS Reduction = 29 days @ 20 ^{o}C = 580 days-^{o}C
VSS Reduction Percentage = 580 days-^{o}C = 42% Reduction (from Figure 6-1)
VSS Reduction in 1st and 2nd Stages = 1,311 lbs. VSS x 42% = 551 lbs. VSS/ day
VSS Reduction in 1st Stage = 328 lbs. VSS/day
VSS Reduction in 2nd Stage = 551 lbs. – 328 lbs. = 223 lbs. VSS/day

Calculate Stage #2 Process Oxygen Required

AOR = 223 lbs. VSS/ day x 2.0 lbs. O_2/ lb. VSS destroyed = 446 lbs. O_2/ day
AOR/SOR = 0.3 (*estimated, must be confirmed during design)*
SOR = 446 lbs. O_2/ day / 0.3 = 1,487 lbs. O_2/ day or 1.03 lbs. O_2/ min.
Diffuser Submergence = 14.5 ft.
OTE = 8%
Calculate Air Flow Rate
1.03 lbs. O_2/ min. / (0.075 lbs. / cu. ft. x 23.2% O_2 x 8% OTE) = 742 scfm

Calculate Stage #2 Air Required for Mixing

17,175 cu. ft. x 30 scfm / 1,000 cu. ft. = 515 scfm – *Biological requirements govern*

Digester Stage #3 Aeration Requirements & VSS Reduction

Calculate Stage #3 detention time assuming 2.5% solids

867 cu. ft. / day because no re-thickening in Digester #2

16,455 cu. ft. / 867 cu. ft. / day = 19 days

Calculate Stage #3 Air Requirement @ 20 ^{o}C

Digester Temperature = 20 ^{o}C
Detention Time = 9 + 20 + 19 = 48 days
VSS Reduction = 48 days @ 20 ^{o}C = 960 days ^{o}C
VSS Reduction Percentage = 960 days ^{o}C = 46% Reduction (from Figure 6-1)
VSS Reduction 1st, 2nd and 3rd Stage= 1,311 lbs. VSS/ day x 46% = 603 lbs. VSS/day
VSS Reduction in 3rd Stage = 603 lbs. VSS/ day – 551 lbs. VSS/day = 52 lbs. VSS/day

Calculate Stage #3 Process Oxygen Required

AOR = 52 lbs. VSS/ day x 2.0 lbs. O_2/ lb. VSS destroyed = 104 lbs. O_2/ day
AOR/SOR = 0.3 (*estimated, must be confirmed during design)*
SOR = 104 lbs. O_2/ day / 0.3 = 347 lbs. O_2/ day or 0.24 lbs. O_2/ min.
Diffuser Submergence = 14.5 ft.
OTE = 8%
Calculate Air Flow Rate
0.24 lbs. O_2/ min. / (0.075 lbs. / cu. ft. x 23.2% O_2 x 8% OTE) = 173 scfm

Calculate Stage #3 Air Required for Mixing

16,455 cu. ft. x 30 scfm / 1,000 cu. ft. = 493 scfm – *Mixing requirements govern*

Calculate design conditions for positive displacement blowers 1,800 scfm at 7 psig

Aerobic Digester #1, scfm	1,091
Aerobic Digester #2, scfm	742
Aerobic Digester #3, scfm	493
Total	2,326

Use three PD Blowers on VFD's @ 1,200 scfm each

Calculate solids remaining after digestion

(1,311 lbs. VSS WAS – 603 lbs. VSS Destroyed) + 370 lbs. fixed solids = 1,078 lbs. sludge / day

Liquid Digested Sludge Storage

Recommended Liquid Sludge Storage Volume

(867 cu. ft. / day) x 5 days = 4,335 cu. ft.

4,335 cu. ft. / 12' SWD = 361 sq. ft. – *Use 20' x 20'*

Sludge Dewatering – Centrifuge

Number of Units = 1
Hydraulic Loading Capacity = 80 gpm
Water Content of Cake = 20%

Solids Loading to Centrifuge = Volatile Solids (after reduction) + Fixed Solids = 1,078 lbs. / day

Hydraulic Loading = 6,463 gpd

Calculate Time of Operation

(6,463 gpd / unit) ÷ (80 gpm / unit) = 80 min / day = 9.4 hrs. / week

Recommended Dewatered Sludge Storage

150 days recommended sludge storage

Calculate Sludge from West Side WRF (at 20% solids)

(1,078 lbs. / day DRY) / 20% solids = 5,390 lbs. / day WET
(5,390 lbs. / day) / (8.34 lbs. / cu. ft. x 7.48 gal / cu. ft.) = 86 cu. ft. / day
86 cu. ft. / day x 150 days = 12,960 cu. ft.

Calculate Sludge from Main WWTP (at 22% solids)

(7,069 lbs. / day DRY) / 22% solids = 32,132 lbs. / day wet
(32,132 lbs. / day) / (8.34 lbs. / cu. ft. x 7.48 gal / cu. ft.) = 515 cu. ft. / day
515 cu. ft. / day x 150 days = 77,261 cu. ft.
Note: based on current Main WWTF utilization, sludge is roughly 60% of design

Calculate Total Sludge Storage

Design:
12,960 cu. ft. + 77,261 cu. ft. = 90,221 cu. ft.
90,221 cu. ft. / 3 feet deep = 30,074 sq. ft.

Existing:
12,960 cu. ft. + (60% x 77,261 cu. ft.) = 59,317 cu. ft.
59,317 cu. ft. / 3 feet deep = 19,772 cu. ft.

Recommended Storage = 3 Covered Storage Units, 100 ft. x 100 ft.
Two built now and 1 future as Main WWTF utilization expands

6.4.6 Cost Estimates for Phase III

The proposed improvements address several issues including capacity, regulatory and community needs. Conceptual designs and cost estimates were prepared for both tertiary filtration and tertiary clarification. The summary for each alternative is shown below.

Table 6-4 | Phase III Expansion Probable Cost – With Filters

GENERAL CONDITIONS	$682,000
SITEWORK	$642,100
RAW SEWAGE PUMP STATION	$55,000
HEADWORKS	$151,000
BIOLOGICAL PROCESS	$1,758,437
TERTIARY FILTERS/ CHEM FEED	$2,495,570
RAS PUMP STATION	$76,000
AEROBIC DIGESTION	$170,800
SLUDGE HANDLING BUILDING	$1,415,655
SLUDGE STORAGE BARN	$989,453
SUBTOTAL CONSTRUCTION	$8,436,015
CONTINGENCY 20%	$1,687,203
CONSTRUCTION TOTAL	$10,123,218
ENGINEERING 14%	$1,417,251
PROJECT TOTAL	$11,540,469

Table 6-5 | Phase III Expansion Probable Cost – Without Filters

GENERAL CONDITIONS	$682,000
SITEWORK	$642,100
RAW SEWAGE PUMP STATION	$55,000
BIOLOGICAL PROCESS	$1,758,437
TERTIARY CLARIFIERS	$1,116,750
CHEM FEED	$774,894
RAS PUMP STATION	$76,000
AEROBIC DIGESTION	$170,800
SLUDGE HANDLING BUILDING	$1,415,655
SLUDGE STORAGE BARN	$989,453
SUBTOTAL CONSTRUCTION	$7,681,089
CONTINGENCY 20%	$1,536,218
CONSTRUCTION TOTAL	$9,217,307
ENGINEERING 14%	$1,290,423
PROJECT TOTAL	$10,507,730

The probable cost for the alternative which included tertiary filtration was $11.5 Million, while the total estimated cost for the alternative that included tertiary clarification was $10.5 Million. These estimates were included in the 2007 Facility Plan Update. The construction cost indices for 2007 and 2015 are 876 and 927, respectively. This means that the probable cost has increased to $12.2 Million with tertiary filtration and to $11.1 Million with tertiary clarification.

As stated previously, the City has not yet determined which alternative best fits the community's needs. The City decided to structure its economic model on the higher cost alternative (filtration), but intends to further evaluate each alternative during preliminary design. The improvements can be broken into five categories: Capacity Expansion, Total Phosphorus Standards, Total Nitrogen Standards, Main WWTP Sludge Storage, and Dissolved Oxygen Standards. These estimates were also included in the 2007 Facility Plan Update, and have been modified according to the construction cost index, accordingly.

Table 6-6 | Phase III Expansion Probable Cost Categories

	Capacity	Phosphorus	Nitrogen	Main WWTP Biosolids Storage	Dissolved Oxygen
GENERAL CONDITIONS	$429,660	$27,280	$109,120	$68,200	$47,740
SITEWORK	$630,100	$6,000	$6,000	$0	$0
RAW SEWAGE PUMP STATION	$55,000	$0	$0	$0	$0
HEADWORKS	$151,000	$0	$0	$0	$0
BIOLOGICAL PROCESS	$609,987	$105,750	$1,042,700	$0	$0
TERTIARY FILTERS/ CHEM FEED	$1,571,685	$216,595	$216,595	$0	$490,695
RAS PUMP STATION	$76,000	$0	$0	$0	$0
AEROBIC DIGESTION	$170,800	$0	$0	$0	$0
SLUDGE HANDLING BUILDING	$1,132,524	$0	$0	$283,131	$0
SLUDGE STORAGE BARN	$494,726	$0	$0	$494,726	$0
SUBTOTAL CONSTRUCTION	$5,321,483	$355,625	$1,374,415	$846,057	$538,435
CONTINGENCY 20%	$1,064,297	$71,125	$274,883	$169,211	$107,687
CONSTRUCTION TOTAL	$6,385,779	$426,750	$1,649,298	$1,015,269	$646,122
ENGINEERING 14%	$894,009	$59,745	$230,902	$142,138	$90,457
PROJECT TOTAL (2007)	$7,279,788	$486,495	$1,880,200	$1,157,406	$736,579
PROJECT TOTAL (2015)	$7,703,612	$514,818	$1,989,663	$1,224,790	$779,462

Some of the improvements address immediate needs, such as capacity and regulatory changes, while others address long-term operational costs such as sludge storage and dewatering capabilities. The City has elected to construct the improvements in smaller phases. Phase III-A will address the immediate capacity and regulatory issues while Phase III-B will include construction of the sludge dewatering, sludge storage facilities and others. These estimates were also included in the 2007 Facility Plan Update, and have been modified according to the construction cost index, accordingly.

Table 6-7 | Phase III-A and III-B Probable Costs

	Total	Phase III-A	Phase III-B
GENERAL CONDITIONS	$682,000	$477,400	$204,600
SITEWORK	$642,100	$416,400	$225,700
RAW SEWAGE PUMP STATION	$55,000	$55,000	$0
HEADWORKS	$151,000	$0	$151,000
BIOLOGICAL PROCESS	$1,758,437	$1,758,437	$0
TERTIARY FILTERS/ CHEM FEED	$2,495,570	$2,495,570	$0
RAS PUMP STATION	$76,000	$76,000	$0
AEROBIC DIGESTION	$170,800	$170,800	$0
SLUDGE HANDLING BUILDING	$1,415,655	$0	$1,415,655
SLUDGE STORAGE BARN	$989,453	$494,726	$494,726
SUBTOTAL CONSTRUCTION	$8,436,015	$5,944,334	$2,491,681
CONTINGENCY 20%	$1,687,203	$1,188,867	$498,336
CONSTRUCTION TOTAL	$10,123,218	$7,133,201	$2,990,017
ENGINEERING 14%	$1,417,251	$998,648	$418,602
PROJECT TOTAL (2007)	$11,540,469	$8,131,849	$3,408,620
PROJECT TOTAL (2015)	$12,212,345	$8,605,278	$3,607,067

6.4.7 Operation, Maintenance & Replacement Estimate for Phase III

Power Consumption

Raw Sewage Pumping Station:

Pumps:
(1,050,000 gal / day) / 850 gpm = 1,235 minutes run time = 20.6 hrs. / day
850 gpm utilizes 25 HP
25 HP x (0.7457 kW / HP) x (20.6 hr. / day) x (365 days / yr.) = 140,173 kW / yr.
(140,173 kW-hr / yr.) x ($0.07 / kW-hr) = $9,812 / yr.

Headworks:

Screen:
Run time = 2 hrs. / day @ 2 HP
2 HP x (0.7457 kW / HP) x (2 hr. / day) x (365 days / yr.) = 1,088 kW / yr.
(1,088 kW-hr / yr.) x ($0.07 / kW-hr) = $76 / yr.

Aeration Basins:

Run time = 24 hrs. / day @ 240 HP
240 HP x (0.7457 kW/HP) x (24 hr. / day) x (365 days / yr.) = 1,567,760 kW / yr.
(1,567,760 kW-hr / yr.) x ($0.07 / kW-hr) = $109,743 / yr.

Clarifiers:

Run time = 24 hrs. / day @ 2 HP each
4 HP x (0.7457 kW / HP) x (24 hr. / day) x (365 days / yr.) = 26,130 kW / yr.
(26,130 kW-hr /yr.) x ($0.07 / kW-hr) = $1,829 / yr.

Tertiary Filters:

Run time = 24 hrs. / day @ 10 HP
10 HP x (0.7457 kW / HP) x (24 hr. / day) x (365 days / yr.) = 65,323 kW / yr.
(65,323 kW-hr / yr.) x ($0.07 / kW-hr) = $4,572 / yr.

Reaeration

Run time = 24 hrs. / day @ 10 HP
10 HP x (0.7457 kW / HP) x (24 hr. / day) x (365 days / yr.) = 65,323 kW / yr.
(65,323 kW-hr / yr.) x ($0.07 / kW-hr) = $4,572 / yr.

Ultra-Violet Disinfection:

Data from Trojan based on $0.07 / kW-hr = $7,800 / yr.

RAS/WAS Pump Station:

Pumps:
(610,000 gal / day) / 500 gpm = 1,220 minutes run time = 20.3 hrs. / day
500 gpm utilizes 15 HP
15 HP x (0.7457 kW / HP) x (20.3 hr. / day) x (365 days / yr.) = 82,879 kW / yr.
(82,879 kW-hr / yr.) x ($0.07 / kW-hr) = $5,801 / yr.

Sludge Handling:

WAS Pumps:
To Thickening
(25,200 gal / day) / 160 gpm = 157 minutes run time = 2.625 hrs. / day
160 gpm utilizes 10 HP
10 HP x (0.7457 kW / HP) x (2.625 hr. / day) x (365 days / yr.) = 7,145 kW / yr.
(7,145 kW-hr / yr.) x ($0.07 / kW-hr) = $500 / yr.
PD Blowers:
100 HP
100 HP x (0.7457 kW / HP) x (24 hr. / day) x 365 days / yr. = 653,233 kW / yr.
(653,233 kW-hr / yr.) x ($0.07 / kW-hr) = $ 45,726 / yr.
Thickener:
1 HP
1 HP x (0.7457 kW / HP) x (24 hr. / day) x (365 days / yr.) = 3,266 KW/yr.

(3,266 kW-hr / yr.) x ($0.07 / kW-hr) = $288 / yr.

Sludge Holding:

Centrifuges:
75 HP
(6,223 gal / day) / 80 gpm = 78 minutes run time = 1.3 hrs. / day
75 HP x (0.7457 kW / HP) x (24 hr. / day) x (365 days / yr.) = 26,537 kW / yr.
(26,537 kW-hr / yr.) x ($0.07 / kW-hr) = $1,858 / yr.

Building & Misc. Electrical:

Rough Estimate = $4,400 / yr.

Total Annual Power Consumption = $197,000

Equipment Maintenance

Raw Sewage Pumping Station:
Pumps:
$2,000 / yr.

Headworks Screen:
$1,000 / yr.

Aeration:
$25,000 / yr.

Clarifiers:
$3,000 / yr.

Tertiary Filters:
$3,000 / yr.

Chemical Feed:
$3,000 / yr.

Re-aeration:
$1,000 / yr.

Ultra-Violet Disinfection:
$5,000 / yr.

Sludge Handling:

WAS Pumps:
$1,000 / yr.
PD Blowers:
$2,000/ yr.
Thickener:
$2,000 / yr.

Sludge Handling:

Feed Pumps:
$1,000 / yr.
Centrifuges:
$4,000/ yr.
Conveyor:
$1,000 / yr.

Building, Electrical, Control & Miscellaneous

Rough Estimate = $15,000 / yr.

Total Annual Equipment Maintenance Cost = $69,000

Table 6-8 | Equipment Replacement Probable Cost at 4%

Item	Base Bid	Life	Annual Cost
Raw Sewage Pumps	$161,000	15 YR	$14,480
Screen	$93,000	15 YR	$8,365
Aeration Diffusers	$396,000	20 YR	$29,138
Centrifugal Blowers	$171,000	15 YR	$15,380
PD Blowers	$114,000	15 YR	$10,253
Clarifiers	$306,000	25 YR	$19,588
Clarifier Covers	$180,000	20 YR	$13,245
Chemical Feed System	$95,000	15 YR	$8,544
Tertiary Filters	$567,000	20 YR	$41,720
UV System	$141,000	20 YR	$10,375
WAS Pump	$54,000	15 YR	$4,857
Positive Displacement Blowers	$170,000	15 YR	$15,290
Sludge Diffusers	$261,000	25 YR	$16,707
Sludge Pump	$53,000	15 YR	$4,767
Sampler	$9,000	15 YR	$810
Break Water System	$30,000	15 YR	$2,698
Centrifuge	$575,000	15 YR	$51,711
Control System	$60,000	15 YR	$5,396
Electrical	$348,000	25 YR	$22,276
Piping	$860,000	25 YR	$55,050
Gates, Valves, Misc.	$187,500	25 YR	$12,000
Concrete	$2,830,000	50 YR	$131,740
Building	$2,108,000	50 YR	$98,128
Site Work & Miscellaneous	$1,900,000	50 YR	$88,446
Total			$680,964

Chemical Costs

$FeCl_3$ (35% active)

Phosphorus = 1.05 MGD x 2 mg/L x (8.34 lbs. / gal) x (365 days / yr.) = 6,392 lbs. P / yr.
Ferric Chloride = (6,392 lbs. P / yr.) x (1.5 gal $FeCl_3$ / lb. P) x ($1.00 / gal) = $9,588 / yr.

Methanol (20% active)

Methanol = (37,716 lbs./year CH_3OH) / (20% x 8.34 lbs. / gal) = 22,612 gal / yr.
Methanol = (22,612 gallons / yr.) x ($0.80 / gal) = $18,089 / yr.

Polymer for Dewatering

Dry Cake = (1,038 lbs. / day) x (365 days / yr.) / (2000 lbs. / ton) = 189 dry tons / yr.
Polymer = (189 dry tons / yr.) x (8 lbs. / ton) x ($12 / lb. polymer) = $18,144 / yr.

Annual Chemical Budget

Ferric Chloride	$9,588
Methanol	$18,089
Polymer	$18,144
Total	$45,821

Sludge Disposal

Dry Cake = (1,038 lbs. / day) x (365 days / yr.) / (2000 lbs. / ton) = 189 tons /year
Sludge Cake Disposal = (189 tons / yr.) x ($24 / ton) = $4,536 / yr.

Total Annual Disposal Cost =$4,536 / yr.

Labor Costs

Average Wage Rate = $30 / hr.
Assume 2 men x 8 hours per day
Assume 30% overhead (insurance, 401K, Social Security, etc.)
2 x 8 x (($30 / hr.) x 130%) x (7 days / wk.) = $4,368 / wk.
($4,368 / wk.) x (52 weeks / yr.) = $227,136 / yr.
Total Annual Labor Cost =$227,136 / yr.

Laboratory, Office & Misc. Expenses

Laboratory = $20,000 per year
Office = $5,000 per year
Misc. = $20,000 per year

Total Annual Laboratory, Office & Misc. Expenses = $45,000

TOTAL ANNUAL WASTEWATER TREATMENT FACILITY O,M&R = $1,269,435

Note 1: 53% is dedicated to replacement account
Note 2: Estimated Usage at Start-up is 596,000 gpd

User Fee = $1,269,435 / ((1,050,000 gpd) x (365 days / yr.)) = $3.31 / 1,000 gallons
Break Even = $1,269,435 x 47% / ((596,000 gpd) x (365 days / yr.)) = $2.70 / 1,000 gallons

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SECTION 7
ANTI-DEGRADATION & ENVIRONMENTAL IMPACTS

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7. ANTI-DEGRADATION AND ENVIRONMENTAL IMPACT ANALYSIS

7.1 GENERAL DISCUSSION

The City of St. Charles is responsible for providing sanitary service and treatment for the communities within the Facility Planning Area (FPA). Sections 1 through 6 describe the basins of the FPA that are tributary to the West Side WRF (a.k.a. the West Service Area), the anticipated development, collection system, and treatment facility improvement needs in detail. As the designated management agency, the City 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 and specifically within the West Service Area.

The City has and continues to work with each of the affected communities by providing sanitary service, encouraging responsible development practices, and working with state and local agencies to protect Mill Creek from pollutants.

In addition to actively pursuing solutions to the communities wastewater collection needs, the City has invested in upgrading the West Side WRF with newer technologies to meet the needs of the Mill Creek Watershed. Some of the improvements to protect the environment incorporated into the recent projects include:

- Expansion of the biological process to include ammonia removal
- Upgrade of the sludge stabilization facilities and incorporation of land application
- Installation of ultraviolet disinfection

As shown in Section 5, the performance of the West Side WRF has been outstanding. The BOD_5, suspended solids, and ammonia loadings are continuously well below the NPDES Permit Limits.

The City is committed to upgrading the wastewater treatment facility in a manner that will be a benefit to both the communities served and the ecosystem surrounding Mill Creek. The purpose of this environmental analysis is to identify the parameters of concern with an increase in discharge, as well as to minimize the impact of expansion and improve the existing conditions.

7.2 ENVIRONMENTAL AREAS OF CONCERN

Areas of environmental concern include not only Mill Creek, but the wetlands and nature preserves within the area. The wildlife habitat and open space represent a significant portion of the FPA. The comprehensive plan prepared by the City within the FPA recognizes the importance of preserving open space and incorporating responsible development. Ordinances and development practices to minimize urban run-off from impacting the environment is encouraged.

In 1999, the City contracted with Huff and Huff, Inc. Environmental Consultants to perform a Non-Degradation Analysis for the West Side WRF's proposed expansions. This report found that the West Side WRF's effluent has not had, and is not expected to have, a negative impact on the Mill Creek environment. The Summary of this report states:

> *"In summary, no impact on the beneficial uses of Mill Creek (and Mooseheart Lake) are anticipated from the proposed change in the design average flow. In fact, the resultant higher stream flows under low flow conditions can be expected to benefit both Mill Creek and Mooseheart Lake"*

The most significant concern for the West Side WRF includes the quality of the final effluent. The facility's current effluent quality is exceptional. However, growth within the Facility Planning Area will lead to higher pollutant loading from other sources. Concerns over impacts on the surrounding environment including wetlands, wildlife habitat, and endangered species must be considered in anticipation of potential development.

7.2.1. Water Quality Concerns

The Clean Water Act was established to protect and revive the lakes, rivers, and streams throughout 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, Section 302 of the Illinois Administrative Code 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 water, 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 Publically Owned Treatment Works (POTWs) must meet. The West Side WRF has consistently been in accordance with its NPDES permit 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 Limits for POTW Discharges.

The second method is to study a particular body of water and establish Total Maximum Daily Loads (TMDL's) based on the ecosystem's ability to receive pollutants without having an adverse effect on the streams ability to support its designated uses. By taking a watershed approach, a TMDL considers all potential sources of pollutants, both 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.

In short, a TMDL is calculated using the following equation:

$$TMDL = WLA + MOS + SV$$

Such that:

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 of the state that are considered to be impaired for their intended uses. In 2014, the Illinois EPA issued a revised Integrated Water Quality report and Section 303(d) List. Portions of Mill Creek have been placed on this list.

The City's West Side WRF discharges to segment DTZL-02, which includes 11.1 miles of Mill Creek. This segment has not been identified as impaired on the 303(d) List. Downstream of this is segment DTZL-01, which has been identified as impaired but at a low priority. The assessment was based on site-specific data and concluded that segment DTZL-01 was not supporting primary contact recreation. A summary of these impairments and their causes are shown below:

Table 7-1 | Excerpt 1 from Illinois' 2014 303(d) List and Prioritization: IL_DTZL-01

Order	Priority	Hydrologic Unit Code	Water Name	Water Size	Designated Use	Cause
1490	Low	0712000701	Fox River	3.34	Primary Contact Recreation	Fecal Coliform

The Illinois EPA defines the potential causes and sources of impairment for given water bodies. Specific assessment by the IEPA in 2014 listed no impairments, causes or sources for segment DTZL-02. This data was listed, however, for segment DTZL-01, which are summarized below:

Table 7-2 | Excerpt 1 from Specific Assessment Info. for Streams, 2014: DTZL-01

Cause ID	Description
400	Fecal Coliform

Table 7-3 | Excerpt 2 from Specific Assessment Info. for Streams, 2014: DTZL-01

Source ID	Potential Source Description	Potential Source Guidelines for Identification*
177	**Urban Runoff / Storm Sewers**	Urban and storm sewer runoff based upon actual observation and/or other existing data

**NOTE: Excerpt from Integrated Water Quality Report and Section 303(d) List – Volume I: Surface Water – 2014*

Finally, downstream of segment DTZL-01 is segment DT-38 of the Fox River. This segment has been identified as impaired but at a low priority. The assessment was based on site-specific data and concluded that segment DT-38 was not supporting aquatic life, fish consumption or primary contact recreation. A summary of these impairments and their causes are shown below

Table 7-4 | Excerpt 2 from Illinois' 2014 303(d) List and Prioritization: IL_DT-38

Order	Priority	Hydrologic Unit Code	Water Name	Water Size	Designated Use	Cause
1478	**Low**	**0712000701**	**Fox River**	**10.83**	**Aquatic Life**	**pH, TP, TSS**
1479	**Low**	**0712000701**	**Fox River**	**10.83**	**Fish Consumption**	**Mercury, PCBs**
1480	**Low**	**0712000701**	**Fox River**	**10.83**	**Primary Contact Recreation**	**Fecal Coliform**

Specific assessment information was provided by the IEPA in 2014, and the causes of these impairments are listed as codes which are summarized on the following page:

Table 7-5 | Excerpt 3 from Specific Assessment Info. for Streams, 2014: DT-38

Cause ID	Description
84	Alteration in stream-side or littoral vegetative covers
274	Mercury
319	Other flow regime alterations
348	Polychlorinated Biphenyls (PCBs)
400	Fecal Coliform
403	Total Suspended Solids (TSS)
441	pH
462	Phosphorus (Total)
479	Aquatic Algae

The sources of the impairments were also listed as codes in the 2014 specific assessment, which are summarized on the following page:

Table 7-6 | Excerpt 4 from Specific Assessment Info. for Streams, 2014: DT-38

Source ID	Potential Source Description	Potential Source Guidelines for Identification*
10	**Atmospheric Deposition – Toxics**	Atmospheric deposition of nutrients, minerals, etc. based upon actual observation and/or other existing data.
23	**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.
58	**Impacts from Hydrostructure Flow Regulation / Modification**	Alteration of normal flow regimes (e.g., dams, channelization, impervious surfaces, water withdrawal) based upon actual observation 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
125	**Streambank Modifications / Destabilization**	Shoreline modification/destabilization activities (e.g., bank erosion, rip rap, loss of habitat) based upon actual observation and/or other existing data.
140	**Source Unknown**	No identifiable source based upon available information
142	**Dam or Impoundment**	Dam construction activities based upon actual observation and/or other existing data.
177	**Urban Runoff / Storm Sewers**	Urban and storm sewer runoff based upon actual observation and/or other existing data

**NOTE: Excerpt from Integrated Water Quality Report and Section 303(d) List – Volume I: Surface Water – 2014*

Interestingly, neither "municipal point source discharges" nor "on-site treatment systems" were listed as sources of impairment for segments DTZL-02 or DTZL-01. As such, it can be concluded that the City's West Side WRF does not contribute any substantial harmful pollutants to Mill Creek. However, the future expansion must not cause any noteworthy impairment to segment DT-38 of the Fox River. It is also important to address any at-risk species in the vicinity that could be affected by future pollutant loadings.

7.2.2. **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 West Side WRF. An EcoCAT was conducted for the areas surrounding the facility (this report is included as Appendix B) and determined that the Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Illinois Natural Area Inventory Sites

The Illinois Natural Areas Inventory (INAI) provides a set of information about high quality natural areas, habitats of endangered species, and other significant natural features. Information from the INAI is used to guide and support land acquisition and protection programs by all levels of government as well as by private landowners and conservation organizations. The original INAI was carried out in 1975–78, and it has been maintained by the Illinois Department of Natural Resources since then. Although the INAI has been updated to a certain extent, it no longer fully meets the needs of conservation-minded landowners, land managers, and regulatory agencies.

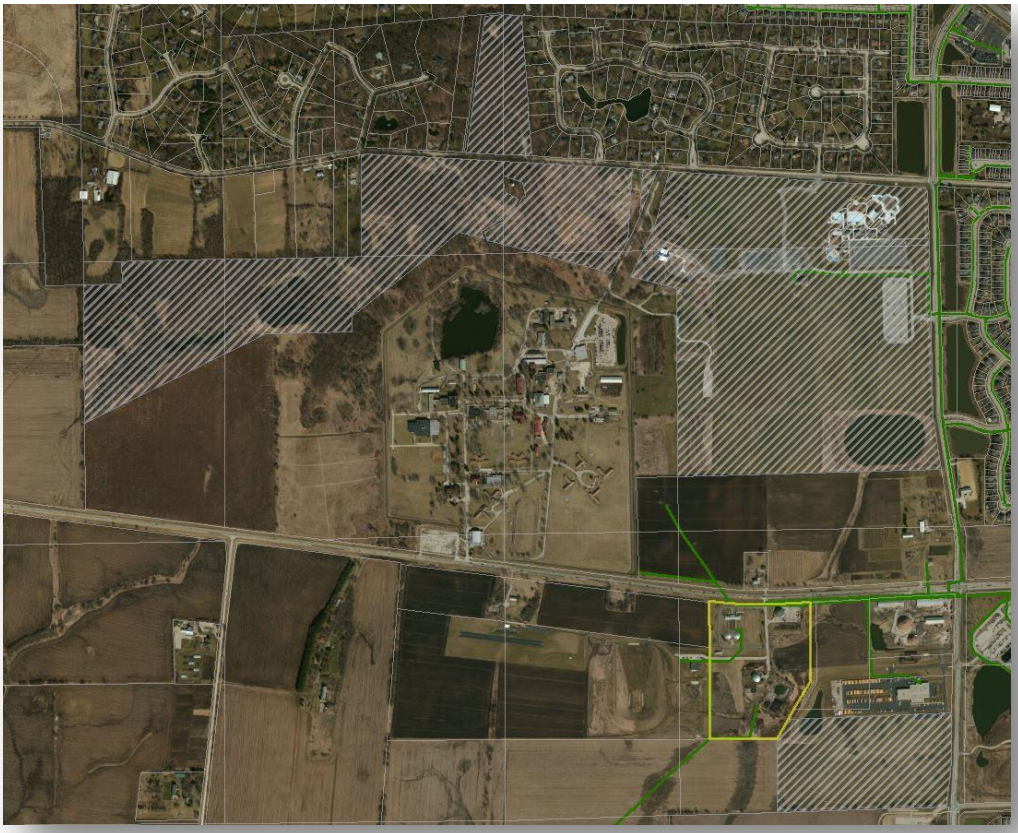
The new INAI process will allow the entire state to be thoroughly and systematically screened in order to find, describe, evaluate, classify, and map natural areas. New technologies and criteria will potentially identify perhaps twice as many natural areas of statewide significance as are currently known.

The Campton Hills Park INAI Site (INAI #1690, Categories II and III) contains just over 115 acres, and is located northwest of the West Side WRF. Prior to expansion, the Illinois Natural History Survey should be contacted to confirm that they will not be negatively impacted by this work.

Registered Land and Water Reserves

The Campton Hills Land and Water Reserve may also be in the vicinity of the project location. An exhibit showing the two protected resources and their location in relation to the West Side WRF is shown in Exhibit 7-1.

Exhibit 7-1 | INAI and Dedicated Nature Preserves near WSWRF (yellow)



An EcoCAT was also conducted for the areas surrounding the facility's discharge into Mill Creek and determined that the Illinois Natural Heritage Database contains no record of State-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves, or registered Land and Water Reserves in the vicinity of the project location. This report is included as Appendix C.

7.2.3. 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 6, the Illinois EPA is focused on statewide nutrient removal criteria for wastewater treatment facilities. To address the water quality concerns with expansion of the West Side WRF, the City intends to meet with the Illinois EPA, Illinois DNR, Friends of the Fox, the Fox River Study Group and Sierra Club.

Sierra Club is America's oldest and largest grassroots environmental organization. The Sierra Club has national, state, and local chapters, which highlight issues of concern on the environment. The Illinois Sierra Club is very active in the study and protection of waterways throughout the state including the Fox River. Similarly, Friends of the Fox is a non-profit organization established for the purpose of protecting and maintaining the quality of the Fox River and its tributaries. Both organizations are attempting to work closely with communities to promote responsible development.

The Fox River Study Group (FRSG) is a coalition formed to address sustainable growth and water quality issues in the Fox River Watershed. The coalition members include Sierra Club, Friends of the Fox, Fox River Ecosystem Partnership, local municipalities, state agencies, and other interested parties. The FRSG scope has expanded its scope to the development of a comprehensive model of the Fox River Watershed. This project has been broken into four phases.

Phase I of this initiative is to compile current water quality and land use information in the watershed. Phase I work is being conducted by the Illinois State Water Survey and funded by the IEPA. Part of the Phase II work began in April 2002 when the FRSG water quality monitoring program started collecting samples at seven sites along the Fox River. This program, an all-volunteer effort organized by the Fox River and Fox Metro Water Reclamation Districts (FRWRD and FMWRD), was carefully designed to satisfy rigorous data quality requirements of the IEPA. Results from this program will be combined with results from Phase I to identify times and locations where additional information is needed.

The overall data, especially information describing how the watershed responds to storm events, will be used in Phase III to calibrate a model of the Fox River watershed. The fourth and final phase is to implement and maintain the watershed model as a management tool. The model will be used for the following purposes:

- Ensure efficient use of taxpayer and private moneys on watershed projects
- Assess the effect of various development options throughout the watershed
- Educate stakeholders
- Evaluate management priorities
- Identify sensitive regions within the watershed
- Develop effective continuing monitoring programs

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 City's existing permit for the West Side WRF expires on May 31st, 2017. Once the permit expires, or if the facility requires expansion, it is anticipated that the new NPDES permit will include a 1.0 mg/L monthly average phosphorus limit and lower ammonia nitrogen levels.

7.3 IMPACTS OF EXPANSION

The most significant impact of expansion on the environment will be from an increased discharge to the Fox River. Based on the February 2003 map, the 7 day -10 year low flow for the Fox River at this point is 101 cubic feet per second.

To assess the impacts of the treatment facility expansion each of the listed potential causes for impairment identified in the 303(d) listing of the segment should be addressed to develop solutions for minimizing or eliminating the impact to the Fox River. Additionally, any additional Water Quality Standards that may be impacted due to an increase in discharge, in accordance with the Section 302.105 *Antidegradation* should also be addressed.

As stated previously, the Illinois EPA has not identified this section of Mill Creek as impaired therefore there are no specific causes for impairment to address. However, typical causes for impairment from municipal wastewater effluents include BOD_5 , total suspended solids (TSS), ammonia nitrogen and phosphorus. As indicated in Section 5, the existing process consistently provides adequate treatment to meet the proposed BOD_5, Total Suspended Solids, and Ammonia effluent limits and any proposed expansion will ensure that these standards will continue to be met.

In the summer of 2004 the Illinois EPA implemented additional nutrient removal criteria for phosphorus. As a part of the proposed expansion the City intends to incorporate phosphorus removal modifications to meet the expected effluent limits of 1.0 mg/l

7.4 REDUCING IMPACTS OF EXPANSION

7.4.1. Reducing Construction Impacts on Wetlands

While the City has no authority to impact or dictate development practices, the City's responsibility is to improve the environment within its jurisdiction through providing superior collection and treatment solutions. The City has developed a collection system plan that minimizes the impact on the existing wetlands and open space. Additionally the use of trenchless technologies such as directional drilling will be utilized when necessary in order to minimize the impact of construction projects. The City is committed to providing any system expansion in a way that minimizes the impact on the existing wetlands and open space.

7.4.2. Water Reuse

One of the methods for reducing the impact from the plant expansion would be to incorporate a water reuse program into the project. Reviewing the Land Use Plan and the Facility Planning Area Boundary, conservation areas and golf courses are the most eligible recipients for reuse water. Through discussions with the stakeholders, it is intended to investigate potential uses for reclaimed water such as irrigation of the plant site or golf courses

7.4.3. **Biological Nutrient Removal**

One approach to mitigating the impacts of the increased discharge quantity is to reduce the concentration of nutrients discharged from the treatment facility. As described in Section 5, the current biological process is single stage nitrification utilizing extended aeration. The performance of the process has been exceptional and produced effluent results well below the current NPDES Permit Limits, including ammonia. However, this process does not address concerns over total nitrogen and phosphorus, which can be contributing factors to algae blooms.

Phosphorus removal in wastewater treatment can be accomplished either through chemical precipitation or by biological means. Most biological phosphorus removal systems include an anaerobic selector zone to promote the survival of microorganisms that adsorb phosphorus. Nitrogen removal is commonly accomplished through the denitrification process. The denitrification process occurs under anoxic conditions, thereby starving the microorganisms for oxygen. The microorganisms are forced to breakdown the nitrate and nitrite molecules produced during nitrification to oxygen and nitrogen gas. An analysis of alternatives for implementing biological nutrient removal to address both phosphorus and nitrogen removal are described in Section 6.

7.4.4. **NPDES Permitting**

The current NPDES Permit has limits on $CBOD_5$, TSS and Ammonia Nitrogen. Based on the historical performance of the facility, it is projected that the expanded West Side WRF will not exceed the current annual permitted pounds contribution for $CBOD_5$, TSS or Ammonia.

In addition, if biological nutrient removal is incorporated into the design, effluent phosphorus and total nitrogen will be significantly reduced. These improvements will result in a net benefit to the Fox River.

Therefore, it is recommended that the future NPDES Permit increases the design average flow to 1.05 MGD and the design maximum flow to 2.63 MGD when development necessitates it. The permit could maintain the same weekly and monthly effluent concentration limits, but incorporate annual limits for BOD_5, TSS, and ammonia to represent the allotted discharge pounds of pollutants in the existing NPDES Permit.

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SECTION 8

SUMMARY AND RECOMMENDATIONS

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8. SUMMARY AND RECOMMENDATIONS

8.1 GENERAL DISCUSSION

In 1989, the City of St. Charles was approached for service by properties west of Randall Road requesting annexation and sanitary sewer service. In response, the City investigated several alternatives including the acquisition of the Department of Corrections wastewater treatment facility, which served the Illinois Youth Center and the Illinois Department of Transportation's garage. The City submitted a Facility Plan Amendment in 1989 to the Northeastern Illinois Planning Commission and the Illinois EPA. An addendum to the Facility Plan Amendment was submitted in August of 1991. The 1991 addendum updated the previously proposed design, construction estimates and development population densities.

In December of 1991, the Facility Plan Amendment and Facilities Planning Area Boundary Change were approved by the Northeastern Illinois Planning Commission to extend the City of St. Charles Service Area west of Randall Road. It was determined at that time that the properties located within this area would be tributary to the Illinois Department of Corrections wastewater treatment facility located on Illinois Route 38. The City commenced with Phase I in 1992, which included purchase of the treatment facility and upgrading the facility to meet NPDES standards. Phase I was completed in 1997.

In 1998, the City updated its FPR which outlined a phased approach for expansion of the treatment facility in three 0.35 MGD increments. The Illinois EPA approved Phases II and III as recommended within the FPR which would increase the treatment facility's capacity from 0.35 MGD to 1.05 MGD. The IEPA issued an NPDES Permit consistent with the recommendations allowing for the Phase II expansion to 0.70 MGD and Phase III expansion to 1.05 MGD.

Once the Facility Plan was approved, the City of St. Charles proceeded with design and construction of the Phase II Improvements. The project completed in 2001 and funded through the Illinois EPA Revolving Loan Program. The community has continued to grow in accordance with the Comprehensive Plan and 1998 Facility Plan. The City commissioned this study to update the 2007 Facility Plan, to incorporate more detailed development information as well as address regulatory changes.

8.2 POPULATION EQUIVALENTS AND WASTEWATER FLOWS

Section 2 of this report included an evaluation of the current and projected population equivalents, wastewater flows and pollutant loadings. The West Side Service Area served 6,275 PE in 2013 and the West Side WRF treated 0.49 MGD of wastewater. Taking into consideration ongoing development, governmental capacity commitments, and potential annexations, the population equivalent of the service area will eventually be increased by 6,111 PE. This equates to a build-out projection of 12,386 PE at an average daily flow (ADDF) of 1,110,000 gal/day or 1.11 MGD.

Table 2-1 | Projected Population and Wastewater Flows

Description	2013 Conditions		Current Development		Build-Out Projection	
	PE	ADDF (MGD)	PE	ADDF (MGD)	PE	ADDF (MGD)
Renaux Manor Basin	1,758	0.14	414	0.04	3,320	0.29
Pine Ridge Basin	11	0.001	65	0.006	326	0.03
Zylstra Basin	280	0.02	0	0.00	320	0.04
Gravity Basin	4,226	0.33	0	0.00	8,420	0.75
Total	**6,275**	**0.49**	**479**	**0.046**	**12,386**	**1.11**
Peaking Factor		3.15		3.98		2.86
Peak Hourly Flow (MGD)		**1.54**		**0.18**		**3.18**

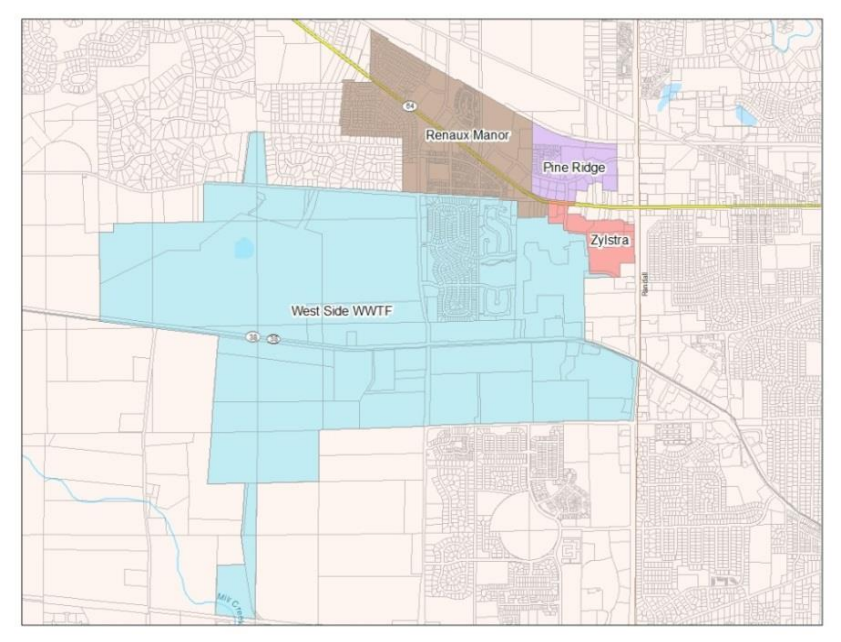
The current West Side WRF has a capacity of 700,000 gallons per day (0.700 MGD). The 2013 wastewater projections for this service area are 487,350 gallons per day. This value includes 40,832 gpd committed for increased flow from the Department of Corrections that the City agreed to when the West Side WRF was purchased. Therefore, the remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. Current development will create an average daily flow of approximately 0.54 MGD, and not require the expansion of the West Side WRF. However, build-out conditions will require expansion. When the average influent approaches 80% of its design flow, or 0.56 MGD, it is recommended that the City begin planning for the expansion of the West Side WRF.

8.3 COLLECTION SYSTEM

An assessment of the City's collection system was presented in Section 3. The wastewater collection system includes two service areas generally divided by Randall Road. The sanitary sewers west of Randall Road are tributary to the West Side Water Reclamation Facility (WRF). The majority of the existing sanitary sewers within the West Side WRF's collection system are less than fifteen years old. Most of these properties consist of newer residential neighborhoods and commercial developments constructed with PVC sewer pipe.

The exception would be the sewers contained within the Illinois Youth Center are maintained by the Department of Corrections. These sewers were originally installed in the 1960's and are generally constructed of clay pipe. The 1998 Facility Plan Amendment identified that the sanitary sewer system which serves the Illinois Youth Center had historically been subject to high infiltration and inflow (I/I) which is often found in older areas that contain clay sewer pipe. As a condition of the purchase agreement for the wastewater treatment facility, the Department of Corrections conducted an evaluation of the existing sanitary sewer system to identify and remove infiltration and inflow sources to the collection system.

From this evaluation it was determined that the I/I was limited primarily to direct inflow which was substantially reduced through the improvements made throughout the evaluation. Recognizing the importance of removing infiltration and inflow from the collection system, the City of St. Charles has developed a rigorous maintenance program including root cutting, grouting, sewer lining and other rehabilitation and replacement of the collection system.



The City of St. Charles' Finance Department actively maintains its GASB 34 Report, however, the collection system is not broken out by treatment facility. Therefore the actual value of this asset for the West Service Area is not known. It has been estimated that the City currently maintains 157 miles of sanitary sewer mains (gravity and force main), as well as roughly 4,040 sanitary manholes in the Main and West Service Areas.

Using estimated replacement unit costs for sanitary sewer pipes, sanitary manholes and lift stations, the City owns and maintains a $220 million dollar collection system. Assuming 10% contingency and 15% engineering costs, the replacement of the entire collection system is estimated to cost approximately $275 million. However, the majority of the collection system is not in need of replacement. The service life of a collection system is approximately 75 years, and this life can be extended by approximately 25 years with ongoing maintenance and rehabilitation. Based on straight-line depreciation over this 100-year service life, the City should be reinvesting about $2,751,000 annually toward sanitary sewer collection system rehabilitation.

Approximately 20% of the collection system is already beyond its initial 75-year service life, and may be considered fully depreciated and in need of replacement. The City should be reinvesting $1,403,000 annually toward the replacement of sewers that were installed before 1941 (as a portion of the annual reinvestment). The remaining $1,348,000 should be put towards the annual costs of the CMOM program.

In order to fully fund the long-term viability of the sewer utility, the City's sewer rehabilitation budget should be raised to the aforementioned level if it has not been already. If the money is not used, it should be placed into a replacement account for future use.

8.4 LIFT STATIONS

An assessment of the City's lift stations was presented in Section 4. The City of St. Charles operates and maintains three lift stations within the West Side Service Area. These installations are reasonably new and have been constructed as the City has grown over the past 15 years.

Table 8-2 | Lift Station Asset Value

Lift Station	Equipment	Structure	Force Main	Totals
Pine Ridge	$210,000	$185,000	$110,000	$505,000
Renaux Manor	$250,000	$215,000	$382,000	$847,000
Zylstra	$210,000	$185,000	$409,000	$804,000
Totals	$670,000	$585,000	$901,000	$2,156,000
Design Life, Years	20	50	50	
Annual Replacement	$33,500	$11,700	$18,020	**$63,220**

It should be noted that the above figures do not include the engineering and contingencies that would be involved in a rehabilitation or replacement project. The value of the City's lift station and force main assets is approximately $2,160,000. Based on a straight-line depreciation over the design life of the equipment, structures and force mains, the City should be reinvesting around $65,000 annually toward maintaining and replacing these assets within the West Side Service Area.

While there are several recommended improvements contained within Section 4 of this report, none should require capital costs to address.

8.5 EXISTING WASTEWATER FACILITY

The existing West Side WRF was discussed in Section 5. In 1989, the City of St. Charles was approached by property owners west of Randall Road requesting annexation and sanitary sewer service. In response, the City investigated several alternatives including the acquisition of the Department of Corrections wastewater treatment facility, which served the Illinois Youth Center and the Illinois Department of Transportation's garage. The treatment facility included a 0.35 MGD package treatment plant, polishing pond and sludge drying beds. Effluent from the facility was discharged to Mill Creek near Keslinger Road.

The City submitted a Facility Plan Amendment and request for Facility Planning Area Boundary change in late 1989 and an update in 1991. The boundary change and plan were approved by NIPC and Illinois EPA. The City commenced with Phase I in 1992, which included purchase of the treatment facility and upgrading the facility to meet NPDES standards. Phase I was completed in 1997.

The City updated the Facility Plan again in 1998. The update outlined a phased approach for expansion of the treatment facility, which expanded the plant's capacity in three 0.35 MGD increments. The Illinois EPA approved Phases II and III as recommended with the Facility Plan, which would increase the treatment facility's capacity to 1.05 MGD. However, the Illinois EPA requested that a Facility Plan Update be submitted prior to expansion of the plant to 1.4 MGD to verify capacity requirements. The Illinois EPA issued an NPDES Permit consistent with the recommendations allowing for the Phase II expansion to 0.70 MGD and Phase III expansion to 1.05 MGD.

Once the Facility Plan was approved, the City of St. Charles proceeded with design and construction of the Phase II Improvements. The project was completed in 2001 and funded through the Illinois EPA Revolving Loan Program.

The City updated the Facility Plan again in 2007. This update incorporated phased approach for expansion of the treatment facility as well as an analysis of recently promulgated and pending environmental regulations. The regulatory issues included nutrient removal, suspended solids effluent requirements and bio-solids stabilization, as well as anti-degradation requirements and copper and radium concentrations in the effluent.

While there are several recommended improvements contained within Section 5 of this report, none should require capital costs to address.

8.6 WASTEWATER FACILITY UPGRADE AND EXPANSION PLAN

The upgrades and expansions to the West Side WRF were discussed in Section 6. The service area continues to be developed in accordance with the City's Comprehensive Plan. The analysis presented in Section 5 demonstrated that the West Side WRF is operating at approximately 69% of its design capacity. The City has committed to serve the Department of Corrections which equates to 40,832 gpd, or an additional 6%. The total committed capacity is 75% of design. The Illinois EPA places facilities over 80% of design on Critical Review to ensure that permitting does not exceed design capacity. Once the influent flow and outstanding permits reach 100% of the design capacity, the facility is placed on Restricted Status and additional connections will not be permitted until the facility has been expanded. The City of St. Charles has approximately 318 PE remaining prior to being placed on Critical Review, and approximately 1,718 PE remaining prior to being placed on Restricted Status.

The Northeastern Illinois Planning Commission (now CMAP) and Illinois EPA approved the Phase 2 and Phase 3 Expansions in their review of the 1998 Facility Plan Update. The Illinois EPA requested that a Facility Plan Update be provided prior to approval of the originally recommended Phase 4 – 1.40 MGD expansion. The analysis provided in Section 2 demonstrates that the existing 0.7 MGD has capacity to serve approved development. Phase 3 – 1.05 MGD will be required to serve future development within the West Service Area. The Phase 4 – 1.40 MGD expansion would be recommended when the forecasted hydraulic loading from the additional property, pending development or redevelopment would result in an average daily flow of 0.84 MGD.

Expansion of the treatment facility will require upgrade of the biological process to address recently promulgated and pending environmental regulations. The regulatory issues that should be addressed within this section include nutrient removal, suspended solids effluent requirements, and bio-solids stabilization. Other issues include anti-degradation requirements, and copper and radium concentrations in the effluent.

The proposed improvements address several issues including capacity, regulatory and community needs. Conceptual designs and cost estimates were prepared for both tertiary filtration and tertiary clarification.

The probable cost for the alternative which included tertiary filtration was $11.5 Million, while the total estimated cost for the alternative that included tertiary clarification was $10.5 Million. These estimates were included in the 2007 Facility Plan Update. The construction cost indices for 2007 and 2015 are 876 and 927, respectively. This means that the probable cost has increased to $12.2 Million with tertiary filtration and to $11.1 Million with tertiary clarification.

The City has not yet determined which alternative best fits the community's needs, but has decided to structure its economic model on the higher cost alternative (filtration) and intends to further evaluate each alternative during preliminary design. The improvements can be broken into five categories: Capacity Expansion, Total Phosphorus Standards, Total Nitrogen Standards, Main WWTP Sludge Storage, and Dissolved Oxygen Standards. These estimates were also included in the 2007 Facility Plan Update, and have been modified to the current construction cost index, accordingly.

Table 8-3 | Phase III Expansion Probable Cost Categories

	Capacity	Phosphorus	Nitrogen	Main WWTP Biosolids Storage	Dissolved Oxygen
GENERAL CONDITIONS	$429,660	$27,280	$109,120	$68,200	$47,740
SITEWORK	$630,100	$6,000	$6,000	$0	$0
RAW SEWAGE PUMP STATION	$55,000	$0	$0	$0	$0
HEADWORKS	$151,000	$0	$0	$0	$0
BIOLOGICAL PROCESS	$609,987	$105,750	$1,042,700	$0	$0
TERTIARY FILTERS/ CHEM FEED	$1,571,685	$216,595	$216,595	$0	$490,695
RAS PUMP STATION	$76,000	$0	$0	$0	$0
AEROBIC DIGESTION	$170,800	$0	$0	$0	$0
SLUDGE HANDLING BUILDING	$1,132,524	$0	$0	$283,131	$0
SLUDGE STORAGE BARN	$494,726	$0	$0	$494,726	$0
SUBTOTAL CONSTRUCTION	$5,321,483	$355,625	$1,374,415	$846,057	$538,435
CONTINGENCY 20%	$1,064,297	$71,125	$274,883	$169,211	$107,687
CONSTRUCTION TOTAL	$6,385,779	$426,750	$1,649,298	$1,015,269	$646,122
ENGINEERING 14%	$894,009	$59,745	$230,902	$142,138	$90,457
PROJECT TOTAL (2007)	$7,279,788	$486,495	$1,880,200	$1,157,406	$736,579
PROJECT TOTAL (2015)	$7,703,612	$514,818	$1,989,663	$1,224,790	$779,462

Some of the improvements address immediate needs, such as capacity and regulatory changes, while others address long-term operational costs such as sludge storage and dewatering capabilities. The City has elected to construct the improvements in smaller phases. Phase III-A will address the immediate capacity and regulatory issues while Phase III-B will include construction of the sludge dewatering, sludge storage facilities and others. These estimates were also included in the 2007 Facility Plan Update, and have been modified according to the construction cost index, accordingly.

Table 8-4 | Phase III-A and III-B Probable Costs

	Total	Phase IIIA	Phase IIIB
GENERAL CONDITIONS	$682,000	$477,400	$204,600
SITEWORK	$642,100	$416,400	$225,700
RAW SEWAGE PUMP STATION	$55,000	$55,000	$0
HEADWORKS	$151,000	$0	$151,000
BIOLOGICAL PROCESS	$1,758,437	$1,758,437	$0
TERTIARY FILTERS/ CHEM FEED	$2,495,570	$2,495,570	$0
RAS PUMP STATION	$76,000	$76,000	$0
AEROBIC DIGESTION	$170,800	$170,800	$0
SLUDGE HANDLING BUILDING	$1,415,655	$0	$1,415,655
SLUDGE STORAGE BARN	$989,453	$494,726	$494,726
SUBTOTAL CONSTRUCTION	$8,436,015	$5,944,334	$2,491,681
CONTINGENCY 20%	$1,687,203	$1,188,867	$498,336
CONSTRUCTION TOTAL	$10,123,218	$7,133,201	$2,990,017
ENGINEERING 14%	$1,417,251	$998,648	$418,602
PROJECT TOTAL (2007)	$11,540,469	$8,131,849	$3,408,620
PROJECT TOTAL (2015)	$12,212,345	$8,605,278	$3,607,067

An analysis was performed in Section 6 to determine the operation, maintenance and replacement costs of the expanded West Side WRF. From this analysis, the total annual budget was projected to be $1,280,342. It should be noted that approximately 53% of this amount is dedicated to the replacement of existing equipment. The user fees for the west side service area should therefore be $3.34 / 1,000 gallons to accommodate this annual budget.

User Fee = $1,280,342 / ((1,050,000 gpd) x (365 days / yr.)) = $3.34 / 1,000 gallons
User Fee Break Even = $1,280,429 x 47% / ((596,000 gpd) x (365 days / yr.)) = $2.76 / 1,000 gallons

8.7 FINANCIAL IMPACTS

The current user fees are based on a City-wide rate structure which is based on the GASB 34 requirements to address operation, maintenance and replacement costs for the sanitary sewer system. This rate should be adjusted to reflect the recommendations for operation, maintenance and replacement provided within Sections 3, 4 and 6 of this report. Section 3 estimates that the City should be investing approximately $2,751,000 per year into the sanitary sewer replacement/ rehabilitation fund for infrastructure. Section 4 recommends investing approximately $65,000 per year into the rehabilitation/ replacement fund for lift station infrastructure within the service area. Section 6 estimates that the funds required to fully fund the operation, maintenance and replacement of the West Side WRF is $1,280,000 per year. The current City-wide user fee should be adjusted to reflect the recommended figures.

The connection fee for properties within the service area should be adjusted to reflect the cost of expanding the facility. Based on the analysis provided in Section 6 and above in Section 8.6, the estimated cost for capacity is $12.2 Million. The capacity increase equates to 350,000 gallons per day. Therefore, the connection fee should be increased to a one-time fee of $34.86 per gallon of capacity required.

8.8 IMPLEMENTATION SCHEDULE

The remaining uncommitted capacity within the West Side WRF equates to 171,818 gpd or 1,718 PE, which equates to 25% of its design capacity. Current development will create an average daily flow of approximately 0.54 MGD, and not require the expansion of the West Side WRF. However, build-out conditions will require expansion. When the average influent approaches 80% of its design flow, or 0.56 MGD, it is recommended that the City begin planning for the expansion of the West Side WRF.

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APPENDIX A
STC WESTSIDE PLANT NPDES PERMIT

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NPDES Permit No. IL0026808

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: May 31, 2017

Issue Date: June 7, 2012
Effective Date: June 7, 2012

Name and Address of Permittee:

City of St. Charles
Two East Main Street
St. Charles, Illinois 60174-1984

Facility Name and Address:

City of St. Charles - Westside WWTF
3803 Illinois Route 38
St. Charles, Illinois 60175
(Kane County)

Receiving Waters: Mill Creek

In compliance with the provisions of the Illinois Environmental Protection Act, Title 35 of the Ill. Adm. Code, Subtitle C, Chapter I, and the Clean Water Act (CWA), the above-named Permittee is hereby authorized to discharge at the above location to the above-named receiving stream in accordance with the 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:AAH:11083103.bah

NPDES Permit No. IL0026808

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 STP Outfall (Existing WWTF)

Load limits computed based on a design average flow (DAF) of 0.7 MGD (design maximum flow (DMF) of 1.75 MGD).

Excess flow facilities (if applicable) shall not be utilized until the main treatment facility is receiving its maximum practical flow.

From the effective date of this Permit until the completion and start of operation of the Expanded WWTF or the expiration date whichever comes first, 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	
$CBOD_5$**	58 (146)		117 (292)	10		20	2 Days/Week	Composite
Suspended Solids	70 (175)		140 (350)	12		24	2 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						2 Days/Week	Grab
Fecal Coliform***	The monthly geometric mean shall not exceed 200 per 100 mL (May through October)						2 Days/Week	Grab
Ammonia Nitrogen: As (N)								
March	8.8 (22)	22 (55)	29 (72)	1.5	3.8	4.9	2 Days/Week	Composite
April - October	7.0 (18)		18 (44)	1.2		3.0	2 Days/Week	Composite
November-February	15 (36)		39 (96)	2.5		6.6	2 Days/Week	Composite
				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-February				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.
**Carbonaceous BOD_5 ($CBOD_5$) testing shall be in accordance with 40 CFR 136.
***See Special Condition 9.

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

Fecal Coliform shall be reported on the DMR as a monthly geometric mean. No more than 1 sample or 10% of the samples, whichever is greater during the month shall exceed 400 per 100 ml.

pH shall be reported on the DMR as minimum and maximum value.

Dissolved oxygen shall be reported on the DMR as a minimum value.

NPDES Permit No. IL0026808

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 001 STP Outfall (Expanded WWTF)

Load limits computed based on a design average flow (DAF) of 1.05 MGD (design maximum flow (DMF) of 2.63 MGD).

Excess flow facilities (if applicable) shall not be utilized until the main treatment facility is receiving its maximum practical flow.

From the completion and start of operation of the Expanded WWTF until the expiration date of this permit, 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	
$CBOD_5$**	88 (219)		175 (439)	10		20	3 Days/Week	Composite
Suspended Solids	105 (263)		210 (526)	12		24	3 Days/Week	Composite
pH	Shall be in the range of 6 to 9 Standard Units						3 Days/Week	Grab
Fecal Coliform***	The monthly geometric mean shall not exceed 200 per 100 mL (May through October)						3 Days/Week	Grab
Ammonia Nitrogen: As (N)								
March	13 (33)	33 (83)	43 (107)	1.5	3.8	4.9	3 Days/Week	Composite
April - October	11 (26)		26 (66)	1.2		3.0	3 Days/Week	Composite
November-February	22 (55)		58 (145)	2.5		6.6	3 Days/Week	Composite
Phosphorus	8.8 (22)			1.0			3 Days/Week	Composite
Total Nitrogen****	Monitor Only						1 Day/Month	Composite
				Monthly Average not less than	Weekly Average not less than	Daily Minimum		
Dissolved Oxygen								
March-July				N/A	6.0	5.0	3 Days/Week	Grab
August-February				5.5	4.0	3.5	3 Days/Week	Grab

*Load limits based on design maximum flow shall apply only when flow exceeds design average flow.
**Carbonaceous BOD_5 ($CBOD_5$) testing shall be in accordance with 40 CFR 136.
***See Special Condition 9.
****See Special Condition 14.

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

Fecal Coliform shall be reported on the DMR as a monthly geometric mean. No more than 1 sample or 10% of the samples, whichever is greater during the month shall exceed 400 per 100 ml.

pH shall be reported on the DMR as minimum and maximum value.

Dissolved oxygen shall be reported on the DMR as a minimum value.

Phosphorus shall be reported on the DMR as a daily maximum value.

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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

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.

* The sample frequency for the Expanded WWTF shall be 3 Days/Week.

Special Conditions

SPECIAL CONDITION 1. This Permit may be modified to include different final effluent limitations or requirements which are consistent with applicable laws, regulations, or judicial orders. 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 2 operator. The Expanded WWTF shall be operated by a 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 in the event of operational, maintenance or other problems resulting in possible effluent deterioration.

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 (eDMRs) instead of mailing paper DMRs to the IEPA. More information, including registration information for the eDMR program, can be obtained on the IEPA website, http://www.epa.state.il.us/water/edmr/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 eDMRs 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 applicable and are hereby incorporated 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. For the Expanded WWTF - the Permittee shall conduct semi-annual monitoring of the effluent and report concentrations (in mg/l) of the following listed parameters. Monitoring shall begin three (3) months from the completion and start of operation of the Expanded WWTF. The sample shall be a 24-hour effluent composite except as otherwise specifically provided below and the results shall be submitted on Discharge Monitoring Report Forms to IEPA unless otherwise specified by the IEPA. The parameters to be sampled and the minimum reporting limits to be attained are as follows:

STORET CODE	PARAMETER	Minimum reporting limit
01002	Arsenic	0.05 mg/L
01007	Barium	0.5 mg/L
01027	Cadmium	0.001 mg/L
01032	Chromium (hexavalent) (grab)	0.01 mg/L
01034	Chromium (total)	0.05 mg/L
01042	Copper	0.005 mg/L

Special Conditions

00718	Cyanide (weak acid dissociable) (grab)	5.0 ug/L
00720	Cyanide (total) (grab not to exceed 24 hours)	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 (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
01092	Zinc	0.025 mg/L

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.

*1.0 ng/L = 1 part per trillion.
**Utilize USEPA Method 1631E and the digestion procedure described in Section 11.1.1.2 of 1631E.

SPECIAL CONDITION 11. 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 12. 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 23 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.

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 13. 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 Conditions

SPECIAL CONDITION 14. For the Expanded WWTF the Permittee shall design and operate a biological nutrient removal (BNR) treatment process. 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 15. For the Expanded WWTF - the Permittee shall conduct biomonitoring of the effluent from Discharge Number(s) 001.

Biomonitoring

1. 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:

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

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

2. 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.

3. 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.

4. 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 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 may wish to contact the IEPA to request the discontinuance of further sampling at which time the IEPA may require the Permittee to begin the toxicity reduction evaluation and identification as outlined below.

5. Toxicity Reduction Evaluation - Should the results of the biomonitoring program identify toxicity, the IEPA may require that the Permittee prepare a plan for toxicity reduction evaluation and identification. This plan shall be developed 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 for toxicity reduction evaluation within ninety (90) days following notification by the IEPA. The Permittee shall implement the plan within ninety (90) days or other such date as contained in a notification letter received from the IEPA.

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

SPECIAL CONDITION 16. The Permittee shall notify the IEPA in writing once the WWTF expansion has been completed. A letter stating the date that the expansion was completed shall be sent to the following address within fourteen (14) days of the expansion becoming operational:

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

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.

(Rev. 7-9-2010 bah)

APPENDIX B
ECOCAT_1512370

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EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Applicant: Trotter and Associates, Inc.
Contact: Jerry Ruth
Address: 40W201 Wasco Road, Suite D
St. Charles, IL 60175

IDNR Project Number: 1512370
Date: 05/12/2015

Project: 2015 Facility Plan Update - West Side WRF
Address: 3803 Illinois Route 38, St. Charles

Description: A Facility Plan Report (FPR) is a management and planning document used to identify, evaluate, and plan required wastewater facility improvements. It provides an assessment of the collection and treatment systems' abilities to meet both current and future loads, flows and regulatory requirements and provides critical information for improvements to correct current or projected deficiencies. FPRs are required by the Illinois Environmental Protection Agency (IEPA) for any wastewater improvements that change the treatment process or expand the capacity of the wastewater treatment plant.
FPRs are typically updated every five to ten years, or when significant changes in growth or regulatory requirements have occurred or are expected.

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Campton Hills Park INAI Site
Campton Hills Park Land And Water Reserve

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Kane

Township, Range, Section:
40N, 8E, 31

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, 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, compliance with applicable statutes and regulations is required.

Terms of Use

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1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

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3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

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EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

APPENDIX C
ECOCAT_1512389 – DISCHARGE

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EcoCAT
Ecological Compliance Assessment Tool

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Applicant: Trotter and Associates, Inc.
Contact: Jerry Ruth
Address: 40W201 Wasco Road, Suite D
St. Charles, IL 60175

IDNR Project Number: 1512389
Date: 05/12/2015

Project: 2015 Facility Plan Update - West Side WRF Discharge
Address: 3803 Illinois Route 38, St. Charles

Description: A Facility Plan Report (FPR) is a management and planning document used to identify, evaluate, and plan required wastewater facility improvements. It provides an assessment of the collection and treatment systems' abilities to meet both current and future loads, flows and regulatory requirements and provides critical information for improvements to correct current or projected deficiencies. FPRs are required by the Illinois Environmental Protection Agency (IEPA) for any wastewater improvements that change the treatment process or expand the capacity of the wastewater treatment plant.
FPRs are typically updated every five to ten years, or when significant changes in growth or regulatory requirements have occurred or are expected.

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

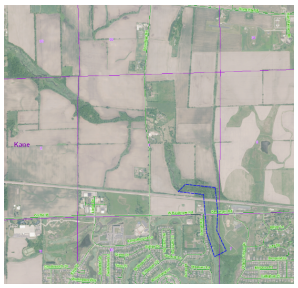
The Illinois Natural Heritage Database contains no record of State-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves, or registered Land and Water Reserves in the vicinity of the project location.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Kane

Township, Range, Section:
39N, 7E, 1
39N, 7E, 12
39N, 8E, 7



IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, 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, compliance with applicable statutes and regulations is required.

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1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

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Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

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