

Preliminary Design Report

Wolcott Wastewater Treatment Plant
Regulatory Support Services

*Unified Government of Wyandotte
County and Kansas City, Kansas*

DECEMBER 2017



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1 Introduction

1.1 Background

The Wolcott Wastewater Treatment Plant (WWTP) is owned and operated by the Unified Government of Wyandotte County and Kansas City, Kansas (UG). The Wolcott WWTP is located within the Connor Creek Basin in the northwestern most reach of UG's service area (see Figure 1-1). The Plant is west of I-435 and north of Wolcott Drive. The legal description is NE¼, Section 12, Township 10 South, Range 23 East.

1.1.1 Previous Reports and Studies

The existing Wolcott WWTP and its respective service area has been the focus of multiple reports and studies performed for the UG. These studies were completed to aide UG in determining the existing capacity and projected growth within the Wolcott service area. Those reports and studies include the following:

- Wolcott Wastewater Treatment Plant Design Memorandum Phase I by Delich Roth & Goodwillie, P.A. Engineers – September 2007
- Wolcott Wastewater Treatment Plant Capacity Evaluation Report by HDR Engineering – January 2014
- Basins West of Muncie Creek Wastewater Master Plan by HDR Engineering – January 2015
- Integrated Overflow Control Plan (IOCP) Draft SSO Characterization Report – August 2015

The 2007 WWTP Design Memorandum, prepared by DR&G, identified the planning information, flow and loading assumptions and a description of the original package WWTP. The information developed as part of the design memorandum was to be utilized in the detailed design for the installation of the package facility.

The 2014 WWTP Capacity Evaluation Study, prepared by HDR, evaluated the existing plant hydraulics and process loadings; identified the unit process in which excess capacity or hydraulic deficiencies existed; recommended improvements to remove hydraulic deficiencies; and presented conceptual cost estimates for implementing the recommended improvements.

The 2015 Wastewater Master Plan, by HDR, evaluated the projected impacts of future growth over a twenty-year planning period on the existing UG collection system and treatment plants located within the UG service area basins west of Muncie Creek. The Master Plan included an evaluation of improvement alternatives and resulted in a 20-year Capital Improvements Plan (CIP) for the Project Area. The Wolcott WWTP Expansion Project and the PS 50 Reroute Project were two projects identified in the CIP. The PS 50 Reroute Project will necessitate the expansion of the Wolcott WWTP. The Wolcott Expansion Project is the focus of this Preliminary Design Report.

The Separate Sewer System (SSS) Characterization Report was completed in August 2015 as part of the overall Integrated Overflow Control Plan (IOCP). The system characterization



documented the existing SSS components within the UG service area and the performance during dry and wet weather. The Report included an analysis of existing data and field investigation reports, and monitoring and modeling of the SSS to better understand how the system responds to various wet weather events and the characteristics of any overflows. The Report established the baseline conditions that will be used to assess the effectiveness of the implemented IOCP. The IOCP is scheduled to be submitted to the United States Environmental Protection Agency (USEPA) in September 2016.

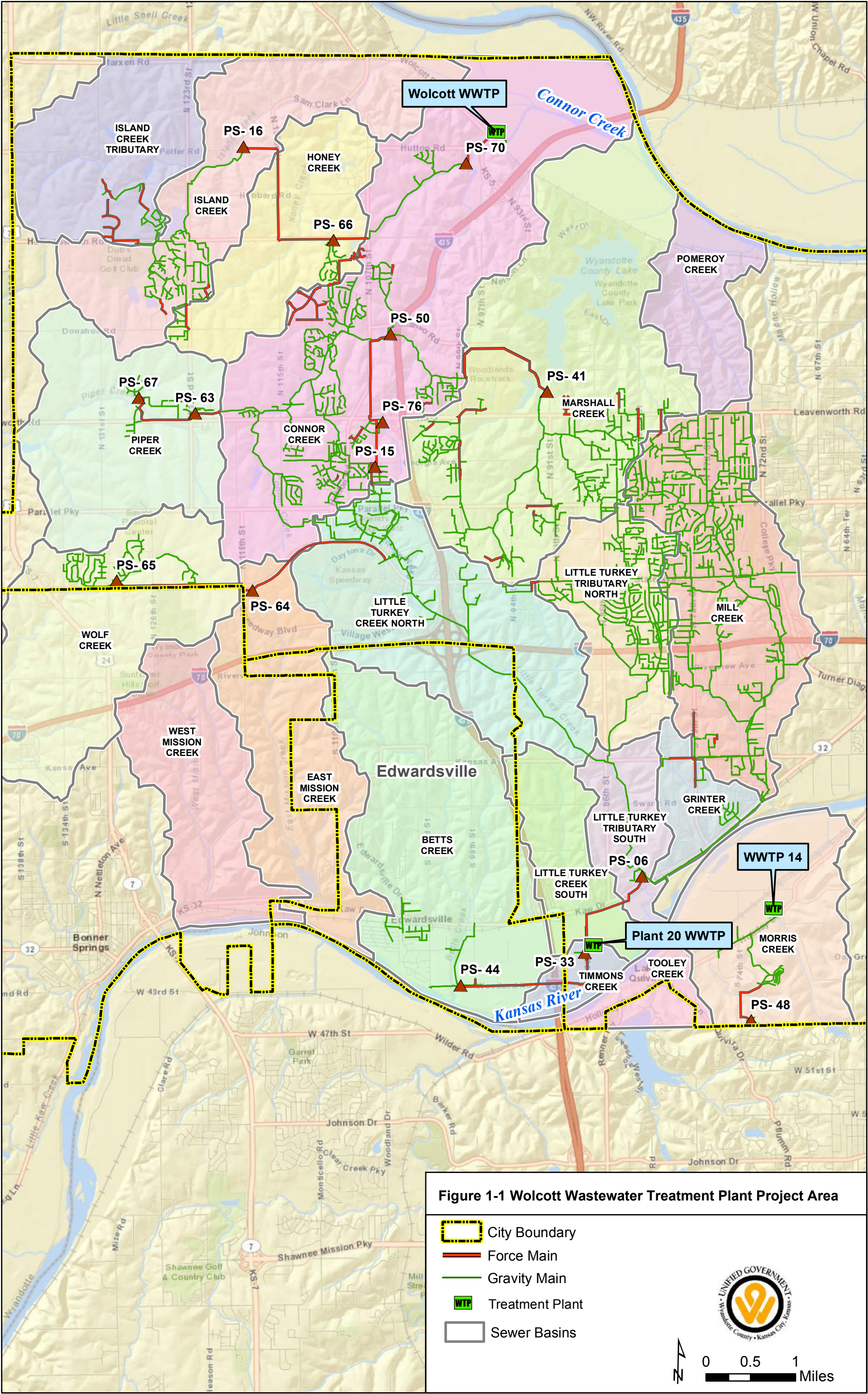


Figure 1-1 Wolcott Wastewater Treatment Plant Project Area

- City Boundary
- Force Main
- Gravity Main
- Treatment Plant
- Sewer Basins



1.1.2 Existing Wastewater Treatment Plant and Service Area

The existing WWTP is a package treatment plant purchased and relocated from the City of Gardner, Kansas in 2007 (see Figure 1-2). The plant has a rated capacity of 0.288 MGD average daily flow and includes a rectangular biological treatment tank with an anaerobic chamber, anoxic chamber, aeration chamber, and an aerobic digester compartment. The plant also includes a final clarifier, ultraviolet disinfection units and flow metering manhole. Sludge is removed from an aerobic digester by vacuum truck for hauling and disposal. The plant effluent is discharged to the Missouri River via Connor Creek.



Figure 1-2 Existing Package Wolcott WWTP

Flow is conveyed to the existing Wolcott WWTP from approximately 130,000 linear feet (LF) of sanitary sewer and seven pump stations within the Island Creek and Honey Creek basins and the northern reaches of the Connor Creek Basin. The existing Wolcott WWTP service area is displayed in Figure 1-3.

The two largest pump stations that convey flow to Wolcott WWTP are Pump Stations 16 and 70. Pump Station 16 conveys flow from Island Creek and Island Creek Tributary to Connor Creek through 13,000 feet of 8-inch force main. Flows are then conveyed by gravity to Pump Station 70. Pump Station 70 pumps flow directly to the Wolcott WWTP through 3,000 feet of 8-inch force main. Pump Station 70 contains two submersible pumps with a total firm capacity of 0.864 MGD, effectively serving as the influent pump station for the plant.

The Kansas Department of Health and Environment (KDHE) issued an NPDES permit and authorization, effective April 1, 2013, for the Wolcott WWTP to discharge into the Missouri River via Connor Creek. The NPDES permit expires on March 31, 2018. The plant permit identifies a rated 0.288 MGD average daily flow but does not contain a maximum hydraulic throughput.



In March 2015, KDHE issued a letter informing the UG of a pending change to the Kansas Surface Water Quality Numeric Criteria for ammonia. The revised Kansas ammonia criteria, based on the latest national recommendations, will significantly lower maximum daily and average monthly limits during the next NPDES permit renewal. The letter indicated the existing Plant may require improvements and operational modifications to reliably achieve compliance with the anticipated revised permit limitations.

The Wolcott WWTP Capacity Evaluation Study, completed in January 2014, determined that the plant has capacity to treat its average daily design flow of 0.288 MGD, and a maximum 3:1 throughput of 0.86 MGD. Based upon existing flow data, the plant is currently at or near its average day design flow, limiting growth within the service area.

As determined by the IOCP and the Master Plan efforts, substantial growth is projected to occur by 2035 in the northwestern reaches of the UG service area including the Island Creek, Honey Creek, and Connor Creek Basins. Flows from these reaches will ultimately be treated at the Wolcott WWTP. Flow from the projected growth will exceed both the dry and wet weather treatment capacity of the Wolcott WWTP and Pump Station 70.

Existing flows from the southern portion of the Connor Creek Basin, as well as flow that is pumped to Connor Creek from the Marshall Creek Basin (via Pump Station 41) and Piper Creek Basin (via Pump Station 63), are currently pumped south to Plant 20 for treatment via Pump Station 50. The alternative recommended in the IOCP and Wastewater Master Plan involves rerouting flow from Pump Station 50 to Wolcott WWTP by gravity, allowing Pump Station 50 to be decommissioned. The expanded Wolcott WWTP will be designed with the capacity to treat the flows rerouted north from Pump Station 50. The Pump Station 50 reroute will reduce the peak and average flows to Pump Station 6 and Plant 20, decreasing the magnitude of the corresponding capacity improvements required in these facilities and the gravity system upstream.

Construction of the expanded Wolcott WWTP along with the rerouting of flows from Pump Station 50, both reduces overflows within the UG Service Area and opens up area for new development. Therefore, this Project was considered in the 2015 Master Plan as the highest priority project in the 20-year CIP and the plan further developed in this Report.

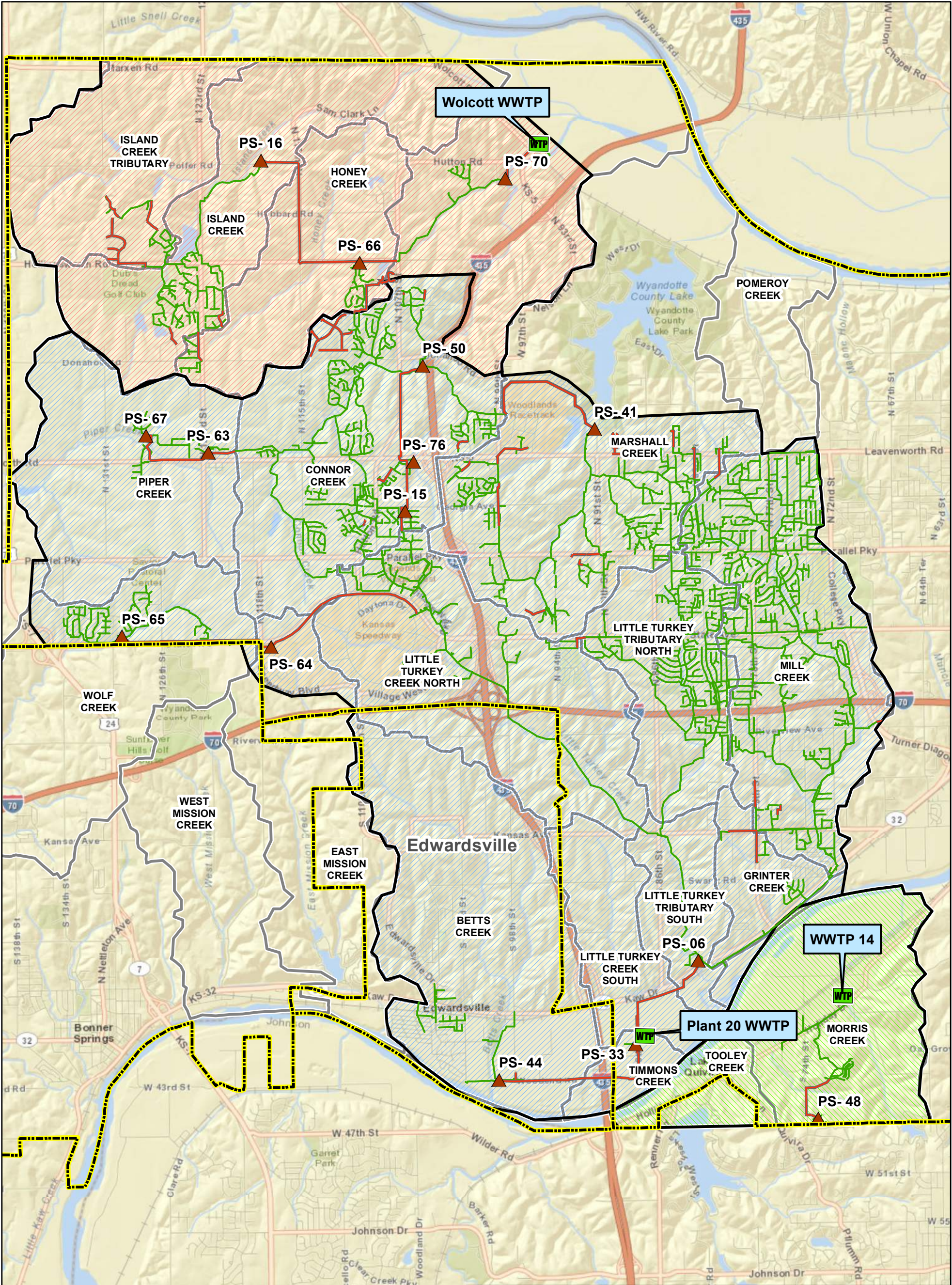
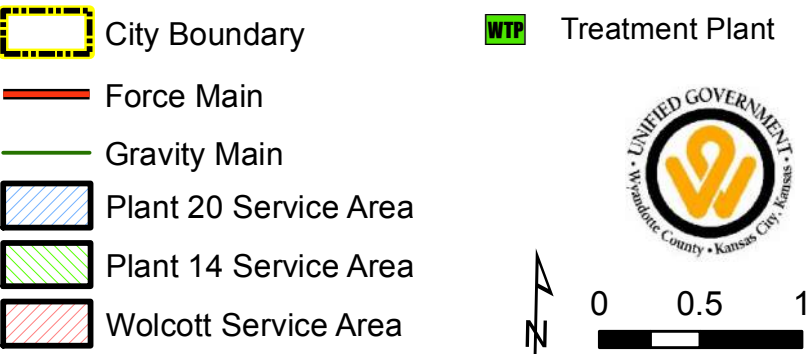


Figure 1-3 Wastewater Treatment Plant Service Areas



1.2 Project Objective and Scope

This Preliminary Design Report is developed as part of the Regulatory Support Services Project. The purpose of the Regulatory Support Project was to enable UG to obtain regulatory approval for the expansion of the Wolcott WWTP by submission of an Antidegradation Review Report to KDHE.

The purpose of the Project is to expand the Wolcott WWTP in to order to address future population and peak flow events and to improve the effluent quality for compliance with the phased implementation of the TMDL and the anticipated NPDES permit requirements. The following Preliminary Design Report presents the conceptual design scope, parameters, performance requirements and approach to support in the detailed design phase services. This report considers three levels of nutrient removal alternatives as defined in the Draft Antidegradation Review Report:

- Biological Nutrient Removal (BNR):
 - o Total nitrogen (TN) 10 mg/L
 - o Total phosphorus (TP) 1 mg/L
- Enhanced Nutrient Removal (ENR):
 - o TN 5 mg/L
 - o TP 0.5 mg/L
- Limits of Technology (LOT):
 - o TN 3 mg/L
 - o TP 0.3 mg/L

The treatment alternatives are discussed in future detail in Section 5.4.

1.2.1 General Requirements

The size of the Wolcott WWTP expansion will be a 4 MGD plant to accommodate the flows rerouted from Pump Station 50 and the anticipated growth during the 20-year planning period. The 2015 Master Plan recommended constructing these improvements in two phases. A 2 MGD plant will initially be constructed and designed for expansion to 4 MGD when necessitated by growth. The plant will have the capacity to treat the current average day flows, from both the Wolcott WWTP and Pump Station 50 service areas, and the projected growth likely to occur within the next several years. The plant will be expanded to 4 MGD when flows from future growth within the service area approach the 2 MGD capacity. It is assumed that certain facilities will be constructed at full size to accommodate the future expansion to 4 MGD.

Future expansions will be required to provide treatment for the projected ultimate growth in the Wolcott WWTP service area. In an effort to establish an approximation of the treatment capacity necessary for ultimate conditions modeling performed during the Master Plan. The projected average daily flow (ADF) for the Wolcott WWTP was 17.6 MGD assuming the PS 50 was rerouted and assuming build-out of all developments within the service area.

The initial unit processes that comprise the proposed Wolcott WWTP include:

- Influent pump station;

- Excess flow holding basin (EFHB);
- Headworks building;
- Biological treatment (BNR, ENR, or LOT);
- Secondary clarifiers;
- UV disinfection;
- Aerobic digesters;
- Solids processing building; and
- Maintenance and laboratory building

The individual unit processes are discussed in further detail in Section 5.

1.2.2 Limited Geotechnical Evaluation

A limited geotechnical evaluation was performed on April 24, 2017 by Alpha-Omega Geotech at the proposed site. The limited evaluation included two (2) borings. The evaluation also took into consideration previous geotechnical work performed by AOG including five (5) borings.

Although limited in nature, the evaluation did result in several recommendations regarding site development and subgrade preparation details. The report indicates that additional borings and laboratory testing may be required. The following evaluation recommendations were included:

- All topsoil and other deleterious material should be striped from the area of the new structures.
- Imported fill material should consist of clean earthen fill free of topsoil, organics, construction debris and other deleterious material.
- The general fill within the structures should be engineered controlled fill placed in lifts not exceeding 6-inches in thickness and compacted to a minimum density of 95-percent of the Standard Proctor (ASTM D698) maximum dry density at moisture content within $\pm$ 3-percent of the optimum moisture content.
- The fill material should be left to pre-load and consolidate the underlying subgrade for at least 9 months prior to installation of structures.
- It may be necessary to over-excavate and construct an engineered controlled fill of select material consisting of properly placed and compacted crusher-run limestone beneath the structures and at an anticipated thickness of 18 to 30 inches ($\pm$).
- Based on the subsurface conditions that have been identified, Site Class E conditions (IBC 2006) may be assumed for seismic conditions.

The report does note that fluctuations of the groundwater level can occur due to seasonal variations in the amount of rainfall and other climatic factors that were not evident at the time the borings were made. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the Project.

1.2.3 Site and Floodplain Permitting

Coordination with the following permitting agencies will be necessary:

- FEMA/Unified Government Floodplain Manager, Buyout Property Restrictions, Floodplain Development Permit

- Unified Government – Preliminary Development Plan
- USACE – 401/404 application
- Kansas Department of Agriculture-Division of Water Resources (KDA-DWR)
- Kansas Department of Wildlife, Parks, and Tourism (KDWPT)
- Kansas State Historic Preservation Office (KS SHPO)
- United States Fish and Wildlife Service (USFWS)

The proposed site location is located within the floodplain fringe. A site location within the floodplain fringe will likely require a floodplain development permit¹ but may not require a No Rise analysis or CLOMR.

On October 5, 2017, on behalf of the UGKCK, HDR received approval for two jurisdictional determinations for the proposed site. A standard jurisdictional determination (AJD NWK-2017-01430 #1) for Conner Creek and abutting wetlands were determined as regulated under Section 404 CWA. A CWA permit will be needed for a new discharge outfall located within this area. A dryland jurisdictional determination (AJD NWK-2017-01430 #2) was approved for the existing site within the property line identified in Figure 2-1. The potential aquatic resources within the property line were determined to be wetland depressions created in uplands incidental to construction activity within the meaning of 51 FR 41217, and are, therefore, non-regulated preamble wetlands. These jurisdictional determinations are valid for a 5-year period from the date of the October 5th letter unless, according to the USACE, new information warrants revision of the determination before the expiration date.

1.3 Applicable Codes and Standards

A complete list of the code and standards, which will govern the design and construction of the Wolcott WWTP, are presented below for each applicable discipline.

1.3.1 Architectural

1. International Building Code 2009 as adopted by Unified Government Chapter 8.
2. International Fire Code – 2009 Edition.
3. Americans with Disabilities Act (ADA) – 2010 Edition
4. Occupational Safety and Health Administration (OSHA)
5. Applicable ASTM Standards
6. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
7. NFPA 101 Life Safety Code – 2009 Edition
8. Other applicable NFPA Standards

1.3.2 Structural

1. International Building Code 2009 as adopted by Unified Government Chapter 8.
2. ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures and Commentary

¹ UG Building Permit pg. 3

3. ACI 350.1-10, Specification for Tightness Testing of Environmental Engineering Concrete Structures.
4. ACI 350.4R-04 Design Considerations for Environmental Engineering Concrete Structures
5. ACI 318-05 Building Code Requirements for Structural Concrete and Commentary.
6. ACI 530-05/ASCE 5-05/TMS 402-05 Building Code Requirements for Masonry Structures.
7. AISC Manual of Steel Construction, 13th Edition.
8. AA ADM 1-05 Aluminum Design Manual.
9. ASCE 7-05 Minimum Design Loads for Buildings and Other Structures
10. Kansas Department of Transportation, - Standard Specifications for State Road and Bridge Construction, 2015.

1.3.3 Mechanical

1. 2009 International Building Code (IBC)
2. Uniform Plumbing Code – 2009 Edition
3. Uniform Mechanical Code – 2009 Edition
4. International Fire Code – 2009 Edition
5. International Fuel Gas Code – 2009 Edition
6. National Fire Protections Association NFPA 820
7. Various Air Moving and Conditioning Association (AMCA) Standards
8. Various American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standards
9. American National Standards Institute (ANSI)
10. Sheet Metal and Air Conditioning Contractors of North America (SMACNA)
11. Air Conditioning and Refrigeration Institute (ARI)
12. Various American Society of Testing and Materials (ASTM) Standards
13. Various National Fire Protection Association (NFPA) Standards

1.3.4 Electrical

1. American National Standards Institute (ANSI):
 - a. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
2. ETL Testing Laboratories (ETL).
3. Environmental Protection Agency (EPA):
 - a. 40 CFR Part 60, Subpart IIII, Protection of Environment, Standards of Performance for New Stationary Sources, Standards for Performance for Stationary Compression Ignition Internal Combustion Engines.
4. Federal Communications Commission (FCC):
 - a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
 - b. Code of Federal Regulations (CFR), 47 CFR 15, Radio Frequency Devices.
5. FM Global (FM).
6. Illuminating Engineering Society of North America (IESNA)
7. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

- a. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - b. 802.3, Information Technology - Local and Metropolitan Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - i. 802.3u: IEEE Standards for Local and Metropolitan Area Networks: Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T.
 - ii. 802.3x: IEEE Standards for Local and Metropolitan Area Networks: Specification for 802.3 Full Duplex Operation.
 - c. C2, National Electrical Safety Code (NESC).
 - d. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
8. The International Society of Automation (ISA):
 - a. S5.1, Instrumentation Symbols and Identification.
 - b. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
 - c. S18.1, Annunciator Sequences and Specifications.
 - d. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
9. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - c. ICS 6, Industrial Control and Systems: Enclosures.
 - d. MG 1, Motors and Generators.
10. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 101, Life Safety Code.
 - c. 780, Standard for the Installation of Lightning Protection Systems.
 - d. 820, Fire Protection in Wastewater Treatment and Collection Facilities.
 - e. 508A, Standard for Safety Industrial Control Panels.
11. National Institute of Standards and Technology (NIST).
12. Society of Cable Telecommunications Engineers (SCTE):
 - a. 77, Specification for Underground Enclosure Integrity.
13. Underwriters Laboratories, Inc. (UL).
 - a. 467, Grounding and Bonding Equipment.
 - b. 497B, Standard for Safety Protectors for Data Communications and Fire-Alarm Circuits.
 - c. 508, Standard for Safety Industrial Control Equipment.
 - d. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.



- e. 924, Standard for Emergency Lighting and Power Equipment.
 - f. 778, Uninterruptible Power Systems.
 - g. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.
 - h. 96A, Standard for Installation Requirements for Lightning Protection Systems.
- 14. United States Department of Energy (USDOE):
 - a. NEPA, the National Energy Policy Act.
- 15. United States Department of Interior Bureau of Reclamation (USDIBR):
 - a. Water Measurement Manual.
- 16. Lighting Protection Institute (LPI)

1.3.5 Other

- 1. Great Lakes – Upper Mississippi River Board (GLUMRB) Ten States Standards Recommended Standards for Wastewater Facilities – 2014 Edition

2 Influent Flow and Loadings

2.1 Existing Flows and Loadings

The existing Wolcott influent flows and loadings were reviewed based on data received from the UG for 2010 to 2015. Several parameters were analyzed including flow, biological oxygen demand (BOD), total suspended solids (TSS), ammonia (NH₃), total Kjeldahl nitrogen (TKN), and total phosphorus (TP).

The 2014 Capacity Evaluation Report utilized a statistical analysis of influent flow and loadings in determining average day (50%), maximum month (92.7%), and maximum day values (99.7%). The results of a statistical analysis are shown in Table 2-1.

Table 2-1 Influent Flow and Loadings (2010 – 2015)

Parameter	Average Daily	Maximum Month	Peak Day
Flow (MGD)	0.20	0.36	1.05
BOD (mg/L)	189.5	623.7	1,437.4
BOD (lb/d)	274.3	1,085.9	4,071.3
TSS (mg/L)	229.0	1,051.3	3,663.0
TSS (lb/d)	404.5	1,981.9	7,657.9
NH ₃ (mg/L)	25.6	32.9	183.2
NH ₃ (lb/d)	37.1	77.9	431.8
TKN (mg/L)	40.7	97.1	192.8
TKN (lb/d)	65.7	175.7	771.3
TP (mg/L)	5.9	17.2	63.9
TP (lb/d)	9.2	30.5	144.7

2.2 Design Flows and Loadings

The design criteria presented in this Preliminary Design Report considers both the existing and projected future flow and loading influences from the Wolcott service area and the Pump Station 50 service area. The projected dry weather flows to Wolcott WWTP and Plant 20 for existing and future (2035) conditions are presented in Table 2-2.



Table 2-2 Projected Average Daily Flows for Existing and Future Conditions

Treatment Facility	Existing Conditions			2035 Conditions	
	Design Capacity	No Reroute	With Reroute	No Reroute	With Reroute
ADF from UG System (MGD)	-	3.93	3.09	8.28	6.03
ADF from Edwardsville (MGD)	-	0.22	0.22	0.35	0.35
Plant 20 ADF (MGD)	7	4.15	3.31	8.63	6.38
Wolcott WWTP ADF (MGD)	0.28	0.21	1.05	1.39	3.64
Project Area Total ADF (MGD)	7.28	4.36	4.36	10.02	10.02

As detailed in Section 1.2.1, the Wolcott WWTP expansion will be constructed in multiple phases. Phase 1, at an average day flow (ADF) of 2 million gallons per day (MGD) will initially be constructed and designed for the Phase 2 expansion to 4 MGD when necessitated by growth. A preliminary site layout based upon the east site is presented in Figure 2-1.

The Phase 1 facility will have the capacity to treat the 1.05 MGD current average day flows, from both the Wolcott WWTP and Pump Station 50 service areas, and the projected growth likely to occur within the next several years. The plant will be expanded to 4 MGD when flows from future growth within the service area approach the 2 MGD capacity. The WWTP service areas with the Pump Station 50 reroute is presented in Figure 2-2.

Sampling was performed at Pump Station 50 to evaluate the additional influent loading that will be rerouted to the expanded Wolcott WWTP. Samples were taken from the PS 50 wet well for a period between July 15, 2015 and August 5, 2015. Testing included BOD, COD, soluble BOD, soluble COD, TSS, VSS, TKN, soluble TKN, TP, orthophosphate, ammonia, and VFA. The results are presented in Table 2-3.

Table 2-3 Pump Station 50 Influent Sampling Results

Sample Date		11/16/2015	11/18/2015	11/23/2015	11/23/2015	11/24/2015	12/1/2015
Sample Time		8:00 AM	8:00 AM	8:15 AM	4:00 PM	7:45 AM	8:30 AM
Parameter	Units	Results					
BOD	mg/L	143	141	143	171	154	88
sBOD	mg/L	56	36	43	54	28	24
COD	mg/L	436	239	339	361	414	198
sCOD	mg/L	119	67	101	101	108	60
pH	SU	7.7	7.7	7.6	7.5	7.8	7.6
ortho-P	mg/L	3.04	2.16	2.68	1.87	2.4	1.28
Ammonia as N	mg/L	30	20.8	25	20.6	28.4	13
TKN	mg/L	46.5	35	47.4	47	43.4	21.8
TP	mg/L	4.94	3.68	5.09	4.78	4.43	2.46
sTKN	mg/L	41.2	31.5	38.1	35	33.5	14.9
TSS	mg/L	232	159	220	260	247	106
VSS	mg/L	196	143	200	204	216	96
VFA - Acetic Acid	mg/L	8	1	5	11	1	<1
VFA - Butyric Acid	mg/L	<1	<1	<1	<1	2	<1
VFA - Isobutyric Acid	mg/L	<1	<1	<1	<1	<1	<1
VFA - Isovaleric Acid	mg/L	<1	<1	<1	<1	<1	<1
VFA - Propionic Acid	mg/L	<1	<1	<1	<1	<1	<1
VFA - Valeric Acid	mg/L	<1	<1	<1	<1	<1	<1

In an effort to determine the design loadings for the proposed Wolcott expansion an evaluation of the existing influent concentrations at Plant 20, Wolcott WWTP and PS 50 were compared. A summary of the influent BOD and TSS for these facilities is presented in Table 2-4.

Table 2-4 Influent BOD and TSS Summary (2014 – 2015)

Facility	Influent BOD (mg/L)	Influent TSS (mg/L)
Plant 20 ⁽¹⁾	187	201
Wolcott WWTP ⁽²⁾	209	263
Pump Station 50 ⁽³⁾	150	224

⁽¹⁾ Estimated average based on the influent Plant 20 DMR data from January 2014 to August 2015.

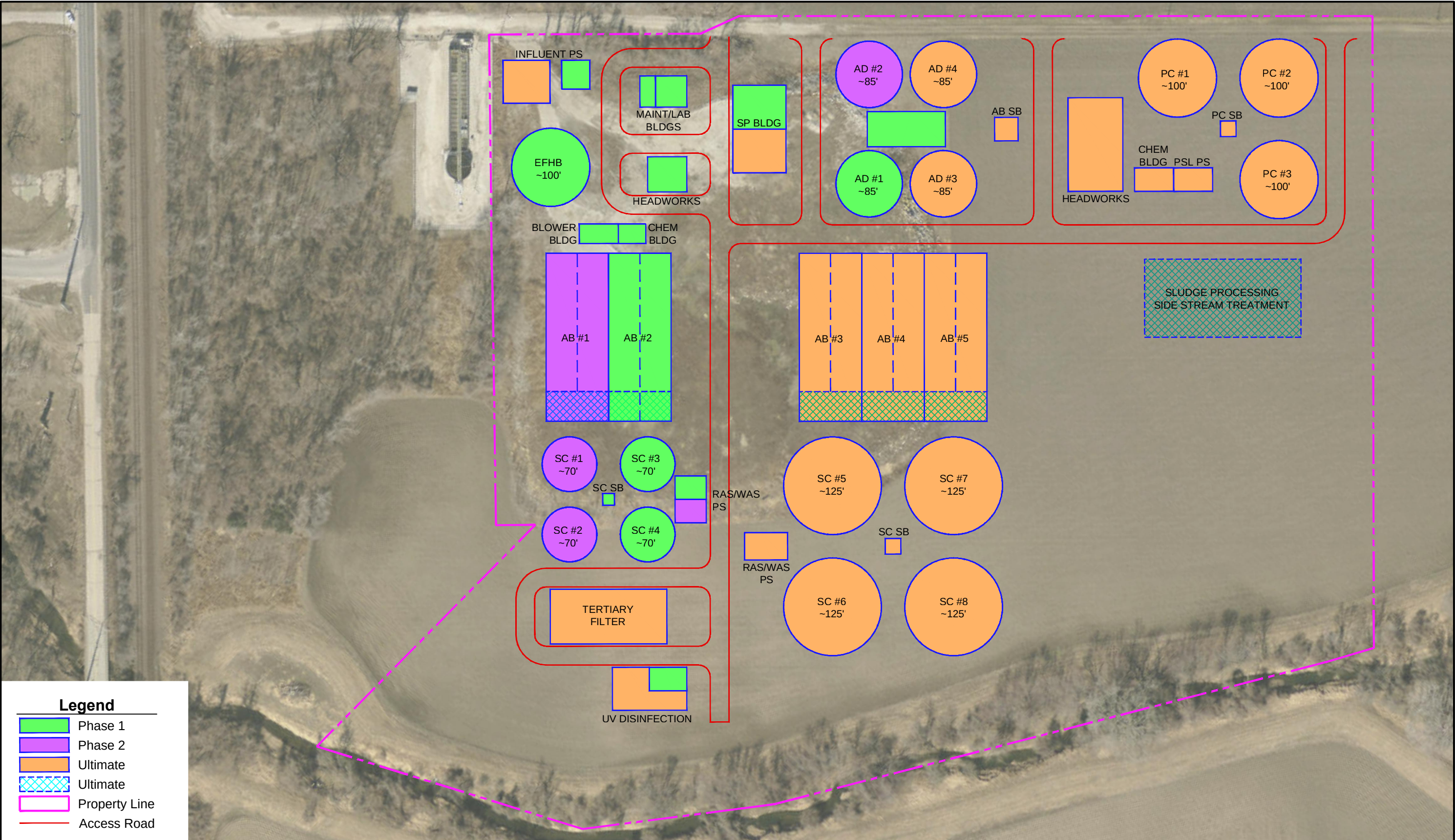
⁽²⁾ Estimated average based on the influent Wolcott WWTP DMR data from January 2014 to August 2015.

⁽³⁾ Estimated average based on influent sampling at PS 50 in November and December 2015 – one outlier was removed.

The design flows and loadings utilized as part of the preliminary conceptual design of the Wolcott WWTP Expansion Project are presented in Table 2-5. The design loadings selected are conservative in an effort to account for the variability of the potential future loadings from Wolcott and PS 50 reroute.

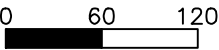
Table 2-5 Design Flow and Loadings

Parameter	Phase 1	Phase 2
Design Average Influent Flow (MGD)	2	4
Assumed Peak Factor	3	3
Peak Influent Flow (MGD)	6	12
BOD (mg/L)	225	225
BOD (lb/d)	3,753	7,506
TSS (mg/L)	250	250
TSS (lb/d)	4,170	8,340
TKN (mg/L)	60	60
TKN (lb/d)	1,001	2,002



Abbreviations

AB = Aeration Basin	PSL = Primary Sludge
AD = Aerobic Digester	RAS = Return Activated Sludge
EFHB = Excess Flow Holding Basin	SB = Splitter Box
PC = Primary Clarifier	SC = Secondary Clarifier
PS = Pump Station	SP = Solids Processing
	UVD = Ultraviolet Disinfection

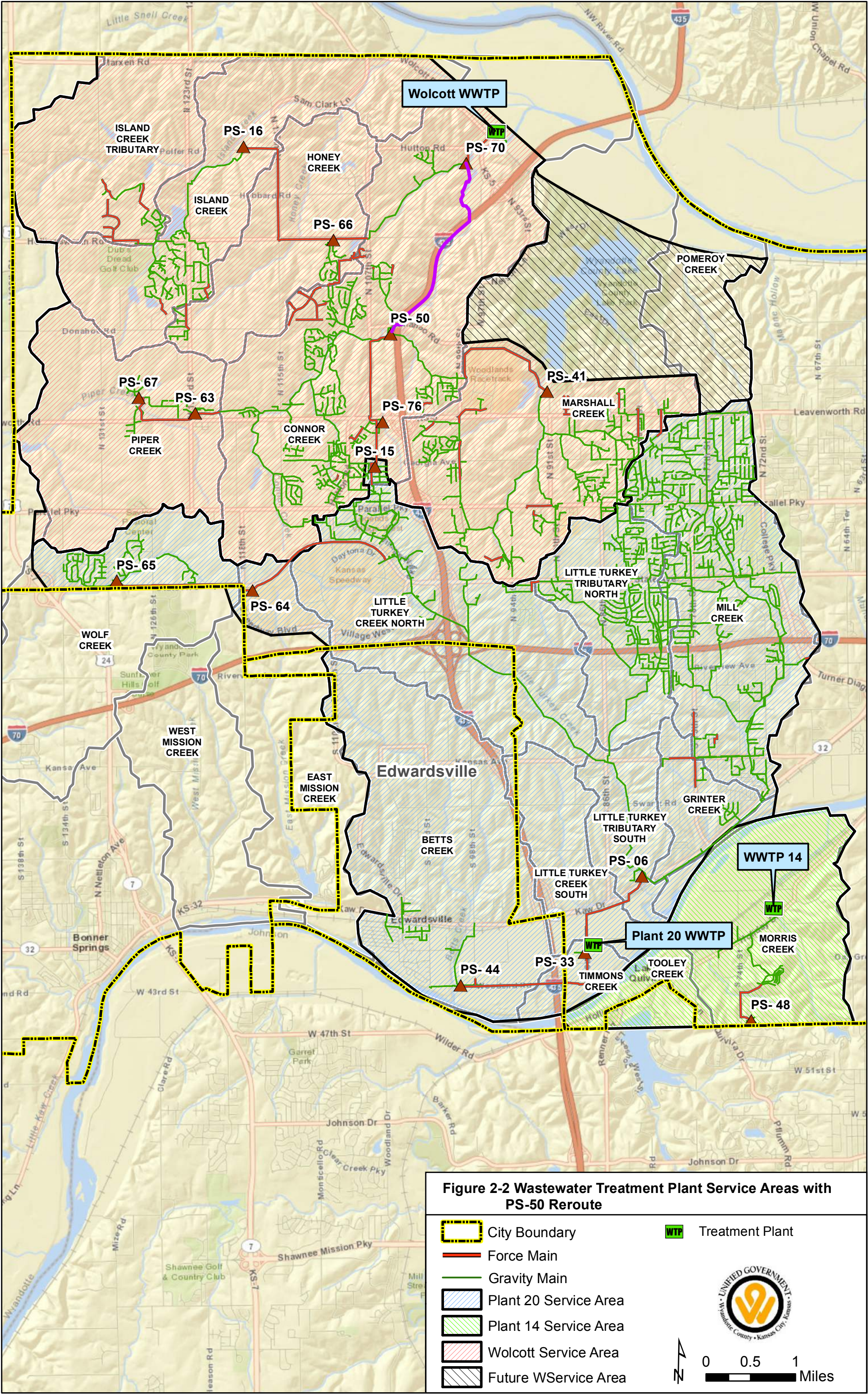


**Unified Government of Wyandotte County
and Kansas City, Kansas
Wolcott Wastewater Treatment Plant**

Preliminary East Site Layout

DATE
FEB 2016

FIGURE
Figure 2- 1



3 Effluent Performance Criteria

3.1 Current Effluent Limits

The Wolcott Treatment Plant discharges to the Missouri River via Connor Creek. KDHE issued an NPDES permit and authorization effective April 1, 2013 for the Wolcott WWTP. The NPDES permit expires on March 31, 2018. The plant permit identifies a 0.288 MGD design average daily flow but does not contain a maximum hydraulic throughput. Table 3-1 presents the current NPDES permit limits and monitoring requirements set forth in the current discharge permit.

Table 3-1 Current NPDES Permit Limits and Monitoring Requirements

Parameter	Units	Daily Max	Weekly Avg	Monthly Avg	Range	Note
BOD	mg/l	-	45	30	-	-
TSS	mg/l	-	45	30	-	-
Ammonia						
January	mg/l	10.3	-	10.3	-	-
February	mg/l	10.3	-	10.3	-	-
March	mg/l	10.3	-	7.6	-	-
April	mg/l	10.3	-	7.6	-	-
May	mg/l	10.3	-	6.6	-	-
June	mg/l	16.2	-	4.7	-	-
July	mg/l	10.3	-	3.5	-	-
August	mg/l	10.3	-	3.5	-	-
September	mg/l	10.3	-	4.3	-	-
October	mg/l	10.3	-	6.6	-	-
November	mg/l	10.3	-	10.3	-	-
December	mg/l	10.3	-	10.3	-	-
E. Coli ⁽¹⁾						
Nov. to Mar.	Colonies/100ml	-	-	3843	-	-
April to Oct.	Colonies/100ml	-	-	427	-	-
pH	Standard	-	-	-	6.0-9.0	-
Total Phosphorus	mg/l	-	-	-	-	Monitor
Total Phosphorus	lbs/day	-	-	-	-	Calculate
TKN	mg/l	-	-	-	-	Monitor
Nitrate+Nitrite	mg/l	-	-	-	-	Monitor
Total Nitrogen	mg/l	-	-	-	-	Calculate
Total Nitrogen	lbs/day	-	-	-	-	Calculate

⁽¹⁾ Represents geometric averages

3.2 Future Effluent Quality

Long-term average effluent concentrations for the Wolcott WWTP were estimated for the three levels of nutrient removal under evaluation (i.e., BNR, ENR and LOT). Estimated averages are intended to reflect long-term plant performance and are not necessarily reflective of permit limits. For all alternatives, estimated averages meet or exceed existing effluent quality (see Table 3-2). Estimated averages are further discussed below by parameter.

- **5-day Biochemical Oxygen Demand (BOD₅)** – All alternatives will achieve BOD₅ levels commensurate with advanced treatment levels. As a long-term average BNR will have an estimated effluent concentration of 5 mg/L, whereas ENR and LOT will have an estimated long-term average of 3 mg/L.
- **Total Suspended Solids (TSS)** - All alternatives will achieve TSS levels commensurate with advanced treatment levels. As a long-term average BNR will have an estimated effluent concentration of 6 mg/L, whereas ENR and LOT will have an estimated long-term average of 3 mg/L.
- **Ammonia as Nitrogen (Ammonia-N)** – All alternatives under evaluation will provide treatment capable of achieving USEPA's 2013 ammonia criteria recommendations, which has not yet been adopted by the KDHE. Long-term averages are estimated for all alternatives at approximately 0.2 mg/L.
- **Total Phosphorus (TP)** – Long-term average TP values are estimated at 1.0 mg/L for BNR, 0.5 mg/L for ENR, and 0.3 mg/L for LOT.
- **Total Nitrogen (TN)** - Long-term average TN values are estimated at 10 mg/L for BNR, 5 mg/L for ENR, and 3 mg/L for LOT.
- ***Escherichia coli* (*E. coli*)** – All alternatives under evaluation will provide equivalent levels of disinfection that will meet seasonal bacteria criteria commensurate with Contact Recreation – Category C protections (i.e., 427 cfu/100mL in the summer and 3,843 in the winter as a geometric mean).

Table 3-2 Estimated Long-Term Average Effluent Concentrations at the Wolcott WWTP

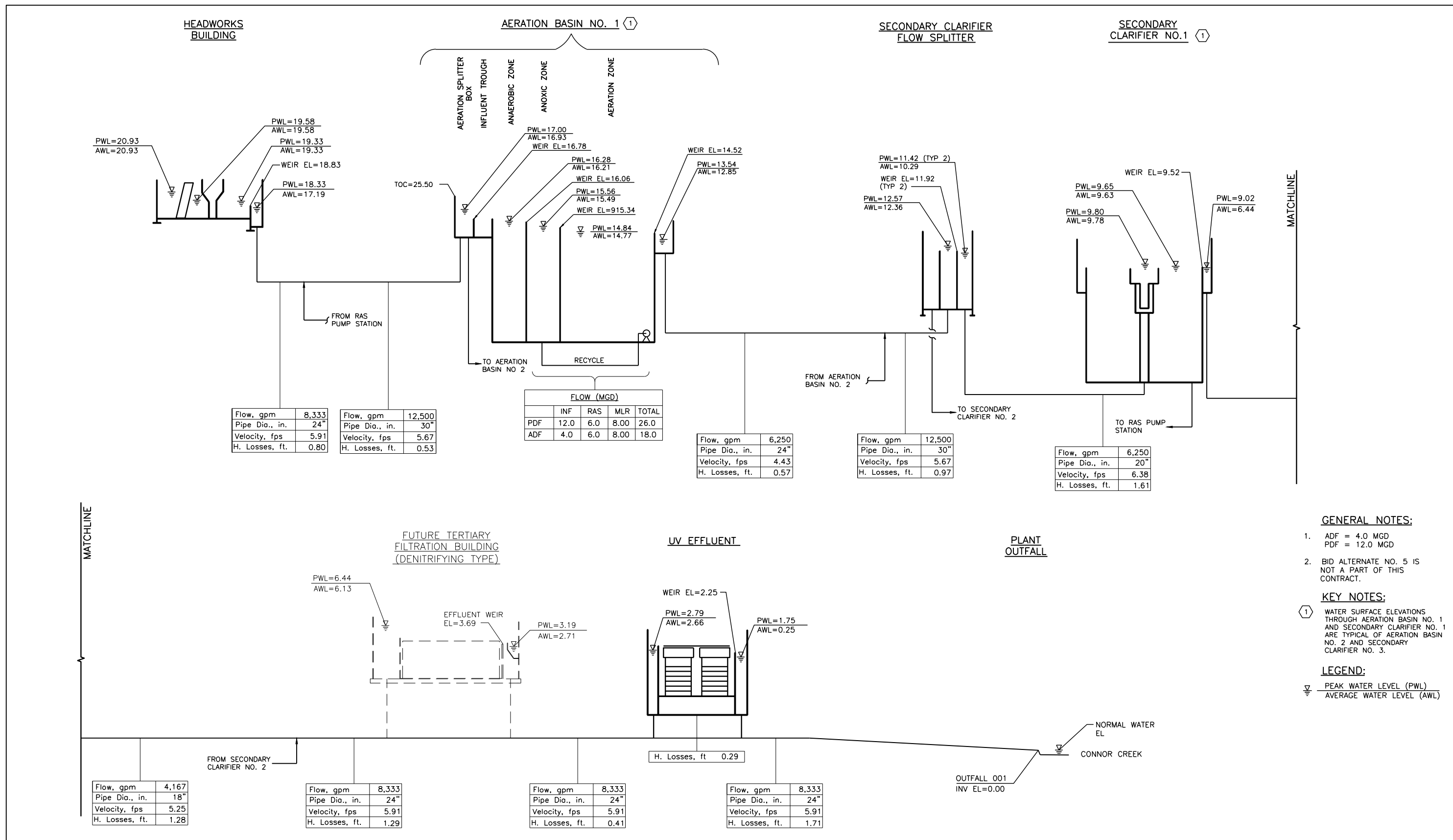
Parameter	Units	Existing	BNR	ENR	LOT
BOD ₅	mg/L	5	5	3	3
TSS	mg/L	6	6	3	3
Ammonia-N	mg/L	1.9	0.2	0.2	0.2
TP	mg/L	1.5	1.0	0.5	0.3
TN	mg/L	16	10	5	3
<i>E. coli</i> (Apr-Oct)	cfu/100mL	427	427	427	427
<i>E. coli</i> (Nov-Mar)	cfu/100mL	3,843	3,843	3,843	3,843

Notes: Long-term average effluent concentrations presented in table are not intended to be representative of permit limits, but rather are for purposes of assessing relative differences in water quality impacts. Final permit limits and goals may differ from table values.

4 Hydraulic Profile

The purpose of the hydraulic profile is to illustrate the selected design control elevations for each of the WWTP unit processes commencing at the influent pipe and ceasing at the plant outfall structure. Design calculations are based upon applicable average and peak flow design capacities of each unit process and reflect accepted practices for water surface freeboard levels.

As detailed in Section 1.2.2, a final site has not been selected. Therefore, the hydraulic profile developed as part of the preliminary design efforts is conceptual only and will be updated as a part of this design when the final site selection has been made. At the time the hydraulic grade line is set, it is important the facilities and associated head losses for the Ultimate Phase are considered. The conceptual hydraulic profile for Wolcott WWTP Phase 1 and 2 is provided in Figure 4-1.



Unified Government of Wyandotte County and Kansas City, Kansas Wolcott Wastewater Treatment Plant

Conceptual Hydraulic Profile

DATE

5-2016

FIGURE

Figure 4-1

5 Unit Process Minimum Design Criteria

The proposed Wolcott WWTP includes:

- Influent pump station;
- Excess flow holding basin (EFHB);
- Headworks building;
- Biological treatment (BNR, ENR, or LOT);
- Secondary clarifiers;
- UV disinfection;
- Aerobic digesters;
- Solids processing building; and
- Maintenance and laboratory building

All unit process shall be designed to the minimum standards presented in the following Section and in accordance with the KDHE Minimum Standards of Design for Water Pollution Control Facilities. The liquid and solid process flow schematic for the proposed Wolcott WWTP is presented in Figure 5-1.



5.1 Influent Pump Station

The purpose of the Influent Pump Station is to hydraulically lift raw wastewater to the necessary elevation that will facilitate gravity flow through all downstream unit processes and discharge to the receiving stream at the design 100-year flood elevation. The pump station will convey influent flows to the headworks and to the EFHB. The pump capacity will be sized to convey peak flows to the EFHB during events when influent flows exceed the hydraulic throughput of the facility.

- Expansion Phase: Phase 1 – station constructed to accommodate 4 MGD average flow
- Influent pumping will require automatic operation 24 hours per day, 7 days a week.
- Pump Type: Submersible non-clog dry pit pumps
- Pump Speed: Variable
- Phase 1 – 2 MGD average flow
 - o Dry Weather Pump Capacity: 2.25 MGD each
 - o Wet Weather Pump Capacity: 4.5 MGD each
 - o Peak Pumping Capacity (all firm pumps in service): 13.5 MGD
 - o Number of Dry Weather Pumps: 2
 - o Number of Wet Weather Pumps: 2
 - o Pump Control: Variable Frequency Drives
- Phase 2 – 4 MGD average flow
 - o Dry Weather Pump Capacity: 3 MGD each
 - o Wet Weather Pump Capacity: 6 MGD each
 - o Peak Pumping Capacity (all firm pumps in service): 18 MGD
 - o Number of Dry Weather Pumps: 2
 - o Number of Wet Weather Pumps: 2
 - o Pump Control: Variable Frequency Drives

5.2 Excess Flow Holding Basin

As part of the 2015 Master Plan, the collection system was modeled to determine future peak flows based on flow monitoring performed throughout the system in 2013 and the additional flows resulting from future populations. Based on this analysis it was determined that the peak future flows will exceed the peak design capacity of the Phase 2 facility. Therefore, as part of this conceptual design it is assumed a prestressed concrete excess flow holding basin (EFHB) will be constructed to store peak flows beyond the peaking capacity of the plant. The EFHB will be constructed as part of Phase 1 to enable the storage of peak wet weather flows resulting from population growth prior to the Phase 2 plant expansion. The EFHB capacity was determined based on a 2-year storm event level of service in accordance with the IOCP.

The EFHB will be constructed to store peak wet weather flows beyond the 3:1 hydraulic throughput of the proposed plant up to the flow typically produced by a 2-year storm event. Following peak events, the liquid stored in the EFHB will be conveyed by gravity to the influent pump station.

- Expansion Phase: Phase 1 – EFHB constructed at full size
- Storage Tank Type: Prestressed Concrete Tank
- Storage Volume: 2 million gallons

- Features: Washdown System

5.3 Headworks Building

The Headworks Building will include influent channels populated by mechanical fine screens with washer/compactors and a manual bar screen. Following the screening process will be grit removal.

5.3.1 Influent Screening

The purpose of influent fine screening is to provide for effective removal of inorganic solids and debris in order to protect downstream equipment and remove particles not suitable for biological degradation. To achieve this, it is proposed to install a manual bar screen and a travelling rake screen with $\frac{1}{4}$ " spacing sized for the design peak flow. A third channel will be constructed for future expansion.

- Phase 1 – 2 MGD average flow
 - o Influent channels: 3 (1 manual bar screen, 1 fine screen, 1 empty channel)
 - o Number of Mechanical Screens: 1
 - o Mechanical Screen Type: Travelling rake screen or perforated plate screen
 - o Mechanical Screen Opening Size: 0.25 in
 - o Standby Screen Type: Manual bar rack type, maximum 1" spacing
 - o Screening system controls
 - o Washer/Compactor for mechanical screen
 - o Peak screening capacity per screen: 6 MGD
- Phase 2 – 4 MGD average flow
 - o Influent channels: 3 (1 manual bar screen, 2 fine screens)
 - o Number of Mechanical Screens: 2
 - o Mechanical Screen Type: Travelling rake screen or perforated plate screen
 - o Mechanical Screen Opening Size: 0.25 in
 - o Standby Screen Type: Manual bar rack type, maximum 1" spacing
 - o Screening system controls
 - o Washer/Compactor, one dedicated for each mechanical screen
 - o Peak screening capacity per screen: 6 MGD (rated at 12 MGD)

5.3.2 Influent Grit Removal

The purpose of grit removal is to settle out a range of inorganic particles in order to remove items not suitable for biological degradation and prevent solids build-up in downstream unit processes. To achieve this, it is recommended to provide a vortex style grit removal system with a self-priming grit removal pump. To reduce organic capture and water content in the settled material, a separate grit hydrocyclone and classifier/washer will be provided to clean and dewater the material prior to discharge in a dumpster.

- Phase 1 – 2 MGD average flow
 - o Peak Grit Removal Capacity (all basins in service): 6 MGD
 - o Minimum Grit Removal Efficiency: 95% at 80 Mesh
 - o Optimize Channel Upstream of Fine Screen and Grit Chamber to Maintain Velocities which keep Solids Suspended During Low Flow Conditions
 - o Number of Firm Grit Chambers: 1

- o Minimum Grit Chamber Diameter: 11 ft
- o Number of Standby Grit Chambers: None
- o Number of Firm Grit Pumps: 1
- o Number of Standby Grit Pumps: 1, uninstalled shelf spare
- o Pump Type: Self-Priming or Flooded Suction Dry-Pit Submersible.
- o Pump Speed: Constant
- o Number of Firm Grit Classifiers: 1, includes grit hydro-cyclone
- o Number of Standby Grit Classifiers: None
- Phase 2 – 4 MGD average flow
 - o Peak Grit Removal Capacity (all basins in service): 12 MGD
 - o Minimum Grit Removal Efficiency: 95% at 80 Mesh
 - o Optimize Channel Upstream of Fine Screen and Grit Chamber to Maintain Velocities which keep Solids Suspended During Low Flow Conditions
 - o Number of Firm Grit Chambers: 2
 - o Minimum Grit Chamber Diameter: 11 ft
 - o Number of Standby Grit Chambers: None
 - o Number of Firm Grit Pumps: 2
 - o Number of Standby Grit Pumps: 1, uninstalled shelf spare
 - o Pump Type: Self-Priming or Flooded Suction Dry-Pit Submersible.
 - o Pump Speed: Constant
 - o Number of Firm Grit Classifiers: 2, includes grit hydro-cyclone
 - o Number of Standby Grit Classifiers: None

5.4 Biological Treatment

The nutrient removal alternatives considered in this Preliminary Design Report is presented in Table 5-1. The process flow schematics for each nutrient removal alternative are presented in Figure 5-2.

Table 5-1 Nutrient Removal Level – Treatment Alternatives

Parameter	BNR	ENR	LOT
TP	1.0	0.5	0.3
TN	10	5	3
Treatment Process	Conventional 3-stage	Conventional 5-stage	Conventional 5-stage
Filtration	-	Denitrifying Filters (3 gpm/ft ²)	Denitrifying Filters (2 gpm/ft ²)
Carbon Addition (TN)	-	10 mg/L to 5 mg/L	10 mg/L to 3 mg/L

The Biological Nutrient Removal (BNR) alternative will include a conventional three-stage, mechanically or diffused aerated, activated sludge system with anaerobic, anoxic and aerobic basins. The anaerobic basin provides for phosphorous removal, accomplished biologically. Chemical phosphorous removal is also included to reliably meet the low effluent phosphorous limit. In the anoxic zone, the carbon source (BOD) is utilized by heterotrophic bacteria to drive nitrogen removal. The aerobic zone promotes and sustains the biomass required for further reduction of BOD and ammonia.

The Enhanced Nutrient Removal (ENR) and Limits of Technology (LOT) alternatives will include a conventional five-stage, mechanically or diffused aerated, activated sludge system with anaerobic, anoxic, aerobic, post-anoxic and post-aeration basins. The 5-stage process will

provide increased nitrogen removal. To meet the anticipated low effluent TN limit a second anoxic basin (post-anoxic) is included. The carbon source (BOD) used by the heterotrophic bacteria in the anoxic basins for the denitrification process is nearly consumed by the post-anoxic stage of the treatment process and a supplemental carbon source, methanol, is added to drive further nitrogen removal. A post-aeration basin is included as a nitrification polishing step. Chemical phosphorous removal is also included to reliably meet the low effluent phosphorous limit. Denitrifying filters will be downstream to further reduce the TN and TP.

To achieve LOT, the flow per unit area within the denitrifying filters is reduced and the chemical phosphorus removal and supplemental carbon addition is increased as compared to the ENR alternative. This is presented in more detail below.

Based on the Draft Antidegradation Review, it is anticipated the BNR treatment alternative will result in water quality improvements that meet required state and federal antidegradation regulations. Therefore, the following biological treatment design criteria present the BNR level of treatment only.

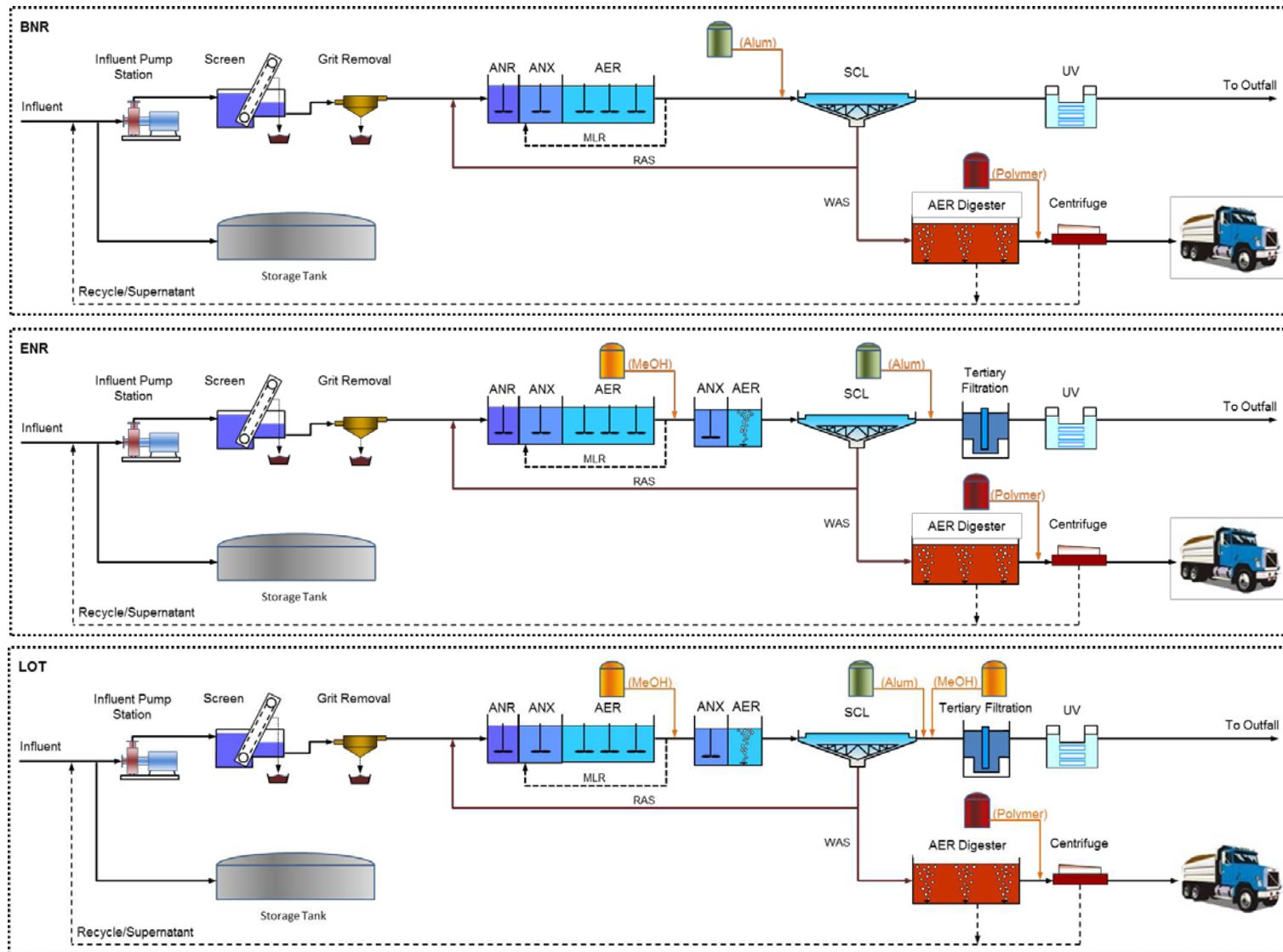


Figure 5-2 Nutrient Removal Alternatives Process Flow Schematics

5.4.1 Biological Nutrient Removal (BNR)

5.4.1.1 BIOLOGICAL TREATMENT SYSTEM – CONVENTIONAL 3-STAGE (MECHANICAL OR DIFFUSED AERATION)

- Phase 1 – 2 MGD average flow
 - o Average Daily Flow: 2 MGD
 - o Peak Hydraulic Capacity (all basins in service): 6 MGD
 - o Minimum Number of Treatment Trains: 2
 - o Basin Water Depth: 18 feet
 - o Hydraulic Retention Time at Average Daily Flow: 27.8 hours
 - o Solids Retention Time at Average Daily Flow: 22 days
 - o Aerobic SRT: 13.2 days
 - o Loading:
 - BOD = 3,753 lbs/day
 - TKN = 1,001 lbs/day
 - o Design MLSS: 3,000 mg/L
- Phase 2 – 4 MGD average flow
 - o Average Daily Flow: 4 MGD
 - o Peak Hydraulic Capacity (all basins in service): 12 MGD
 - o Minimum Number of Treatment Trains: 4
 - o Basin Water Depth: 18 feet
 - o Hydraulic Retention Time at Average Daily Flow: 27.8 hours
 - o Solids Retention Time at Average Daily Flow: 22 days
 - o Aerobic SRT: 13.2 days
 - o Loading:
 - BOD = 7,506 lbs/day
 - TKN = 2,002 lbs/day
 - o Design MLSS: 3,000 mg/L

5.4.1.2 SECONDARY CLARIFICATION

- Phase 1 – 2 MGD average flow
 - o Average Daily Flow: 2 MGD
 - o Peak Hydraulic Capacity (all basins in service): 6 MGD
 - o Design RAS Rate Range: 50% to 150% of average design flow
 - o Number of Basins: 2
 - o Diameter: 70 feet
 - o Side Water Depth: 16 feet
 - o Chemical Addition (upstream of Secondary Clarifiers): 180 gal/day of Alum
 - Chemical Trimming (TP): 3.5 mg/L to 0.5 mg/L
 - o Inlet Area: Center Feed, inner energy dissipating well and outer feed well
 - o Sludge Removal Type: Suction header
 - o Scum Removal Type: Full radius
 - o Maximum Solids Loading Rate: 34 lbs/day/ft² (all basins in service, at peak daily flow)
 - o Maximum Weir Loading Rate: 13,650 gal/day/ft (all basins in service, at peak daily flow)

- o Maximum Hydraulic Loading Rate: 780 gal/day/ft² (all basins in service, at peak daily flow)
- Phase 2 – 4 MGD average flow
 - o Average Daily Flow: 4 MGD
 - o Peak Hydraulic Capacity (all basins in service): 12 MGD
 - o Design RAS Rate Range: 50% to 150% of average design flow
 - o Number of Basins: 4
 - o Diameter: 70 feet
 - o Side Water Depth: 16 feet
 - o Chemical Addition (upstream of Secondary Clarifiers): 360 gal/day of Alum
 - o Inlet Area: Center Feed, inner energy dissipating well and outer feed well
 - o Sludge Removal Type: Suction header
 - o Scum Removal Type: Full radius
 - o Maximum Solids Loading Rate: 34 lbs/day/ft² (all basins in service, at peak daily flow)
 - o Maximum Weir Loading Rate: 13,650 gal/day/ft (all basins in service, at peak daily flow)
 - o Maximum Hydraulic Loading Rate: 780 gal/day/ft² (all basins in service, at peak daily flow)

5.5 UV Disinfection Building

- Design UVT: 65% for effluent
- System Type: Open Channel
- Lamp Type: Low Pressure High Output
- Reactor type. Open-channel type UV system
- Assumed dosage: 30 mJ/cm² minimum
- Lamp Sleeve Cleaning System: Hydraulic or pneumatic
- UVT Meter
- Phase 1 – 2 MGD average flow
 - o Peak Design Capacity: 6 MGD
 - o Total Number of Channels: 2
 - o Number of Populated UV Channels: 1
 - o Number of Unpopulated Channels: 1
 - o Number of Modules: 1 firm/1 standby
- Phase 2 – 4 MGD average flow
 - o Peak Design Capacity: 12 MGD
 - o Total Number of Channels: 2
 - o Number of Populated UV Channels: 2
 - o Number of Unpopulated Channels: None
 - o Number of Modules: 2 firm/1 standby

5.6 Solids Processing Building

- Dewatering Equipment Type: Centrifuge
- Minimum Required Cake Discharge % Solids: 18%
- Polymer Feed System with static mixer and injection equipment.
- Dewatered Cake Discharge Conveyor Type: Shaftless Screw.



- Conveyor to discharge within building to disposal vehicle. Disposal vehicle not included.
- Phase 1 – 2 MGD average flow
 - o Number of Dewatering Units: 1, no standby unit required
 - o Polymer Dosage: 40 lbs/day
- Phase 2 – 4 MGD average flow
 - o Number of Dewatering Units: 2, no standby unit required
 - o Polymer Dosage: 80 lbs/day

5.7 Aerobic Digesters/Storage

- Tank Diameter: 85 feet
- Side Water Depth: 18 feet
- Aeration Type: Floating Aerators
- Phase 1 – 2 MGD average flow
 - o Number of Basins: 1
 - o Volume: 0.75 MG
 - o Days Digestion/Storage at 1.5% Solids: 30
- Phase 2 – 4 MGD average flow
 - o Number of Basins: 2
 - o Volume: 1.5 MG
 - o Days Digestion/Storage at 1.5% Solids: 30

5.8 Administration and Laboratory Building

The proposed Administration and Laboratory Building is as follows (areas listed are intended to be approximate):

- Laboratory and administration building – 1,600 square feet (sf)
- Attached metal maintenance building – 800 sf

6 Preliminary Cost Opinion

The preliminary capital cost summary for each nutrient removal alternative is presented in Table 6-1. The estimated net present worth for Phase 1 only and Phase 1 and Phase 2 is presented in Table 6-2 and Table 6-3, respectively. The estimated capital costs and annual operations and maintenance costs are detailed in Appendix A – Capital Costs and Annual O&M.

Table 6-1 Capital Cost (Phase 1 and Phase 2)

Nutrient Removal Level	BNR	ENR	LOT
Capital Cost – Phase 1⁽¹⁾	\$37,780,000	\$48,750,000	\$52,990,000
Capital Cost – Phase 1 and 2⁽¹⁾	\$57,750,000	\$78,810,000	\$87,450,000

⁽¹⁾Wolcott WWTP costs include a site access bridge.

Table 6-2 20-Year Net Present Worth (Phase 1)

Nutrient Removal Level	BNR	ENR	LOT
Present Worth of Capital Cost⁽¹⁾	\$37,780,000	\$48,750,000	\$52,990,000
Decommissioning PS 70	(\$50,000)	(\$50,000)	(\$50,000)
Wolcott (2 MGD) O&M	\$615,000	\$907,000	\$1,056,000
Existing Wolcott (0.288 MGD) O&M	(\$74,000)	(\$74,000)	(\$74,000)
Present Worth of Annual O&M⁽²⁾	\$6,680,000	\$10,600,000	\$12,700,000
Estimated Net Present Worth	\$44,460,000	\$59,350,000	\$65,690,000

⁽¹⁾Wolcott WWTP costs include an influent pump station, EFHB, and an access bridge.
⁽²⁾Assuming an inflation rate of 3%, a prescribed discount rate of 4%, and a planning period of 20 years.

Table 6-3 20-Year Net Present Worth (Phase 1 and Phase 2)

Nutrient Removal Level	BNR	ENR	LOT
Present Worth of Capital Cost⁽¹⁾	\$57,750,000	\$78,810,000	\$87,450,000
Decommissioning PS 70	(\$50,000)	(\$50,000)	(\$50,000)
Wolcott (4 MGD) O&M	\$1,223,000	\$1,805,000	\$2,102,000
Existing Wolcott (0.288 MGD) O&M	(\$74,000)	(\$74,000)	(\$74,000)
Present Worth of Annual O&M⁽²⁾	\$14,940,000	\$22,800,000	\$26,900,000
Estimated Net Present Worth	\$72,690,000	\$101,610,000	\$114,350,000

⁽¹⁾Wolcott WWTP costs include an influent pump station, EFHB, and an access bridge.
⁽²⁾Assuming an inflation rate of 3%, a prescribed discount rate of 4%, and a planning period of 20 years.



7 Implementation Schedule

The proposed implementation schedule is presented in Table 7-1. Design can begin in fall 2016 with Phase 1 construction completed in early 2020. The Phase 2 construction of the 4 MGD expansion is estimated to begin in 2025, though the timing of this expansion will ultimately be predicated upon the rate of growth within the Wolcott service area.

Table 7-1 Phase 1 Implementation Schedule

Project Activity	Duration	Start Date
Phase 1 Design	12 months	January 1, 2017 – Notice to proceed
KDHE Review	3 months	January 1, 2018
Bidding	3 months	April 1, 2018
Phase 1 Construction	2 years	July 1, 2018



Appendix A – Capital Costs and Annual O&M

Estimated Capital Cost Summary

Nutrient Removal Level	PHASE 1 (2 MGD)			PHASE 2 (4 MGD)			TOTAL		
	BNR	ENR	LOT	BNR	ENR	LOT	BNR	ENR	LOT
FACILITIES	CONVENTIONAL (3 STAGE)	CONVENTIONAL (5 STAGE)		CONVENTIONAL (3 STAGE)	CONVENTIONAL (5 STAGE)		CONVENTIONAL (3 STAGE)	CONVENTIONAL (5 STAGE)	
Influent Pump Station ⁽¹⁾	\$3,680,000	\$3,680,000	\$3,680,000	\$80,000	\$80,000	\$80,000	\$3,760,000	\$3,760,000	\$3,760,000
Headworks	\$1,120,000	\$1,120,000	\$1,120,000	\$450,000	\$450,000	\$450,000	\$1,570,000	\$1,570,000	\$1,570,000
Aeration Basin	\$3,685,000	\$4,830,000	\$4,830,000	\$3,685,000	\$4,830,000	\$4,830,000	\$7,370,000	\$9,660,000	\$9,660,000
Chemical Addition Building	\$450,000	\$510,000	\$510,000	\$0	\$0	\$0	\$450,000	\$510,000	\$510,000
RAS/WAS Pump Station	\$590,000	\$590,000	\$590,000	\$440,000	\$440,000	\$440,000	\$1,030,000	\$1,030,000	\$1,030,000
Secondary Clarifiers	\$1,871,000	\$1,871,000	\$1,871,000	\$1,871,000	\$1,871,000	\$1,871,000	\$3,742,000	\$3,742,000	\$3,742,000
Tertiary Filtration (dN) Building	-	\$4,960,000	\$7,310,000	-	\$4,780,000	\$7,210,000	-	\$9,740,000	\$14,520,000
UV Disinfection Building	\$1,050,000	\$1,050,000	\$1,050,000	\$120,000	\$120,000	\$120,000	\$1,170,000	\$1,170,000	\$1,170,000
Laboratory and Administration Building	\$640,000	\$640,000	\$640,000	\$0	\$0	\$0	\$640,000	\$640,000	\$640,000
Biosolids - Centrifuge	\$700,000	\$700,000	\$700,000	\$400,000	\$400,000	\$400,000	\$1,100,000	\$1,100,000	\$1,100,000
Biosolids - Digesters ⁽²⁾	\$1,300,000	\$1,300,000	\$1,300,000	\$1,300,000	\$1,300,000	\$1,300,000	\$2,600,000	\$2,600,000	\$2,600,000
Odor Control	\$410,000	\$410,000	\$410,000	\$0	\$0	\$0	\$410,000	\$410,000	\$410,000
Less Deep Foundations	(\$3,032,250)	(\$3,750,850)	(\$3,890,850)	(\$2,396,500)	(\$3,115,100)	(\$3,255,100)	(\$5,428,750)	(\$6,865,950)	(\$7,145,950)
Subtotal	\$12,463,750	\$17,910,150	\$20,120,150	\$5,949,500	\$11,155,900	\$13,445,900	\$18,413,250	\$29,066,050	\$33,566,050
Electrical I&C (20%)	\$2,492,750	\$3,582,030	\$4,024,030	\$1,189,900	\$2,231,180	\$2,689,180	\$3,682,650	\$5,813,210	\$6,713,210
Site Piping (11%)	\$1,371,013	\$1,970,117	\$2,213,217	\$654,445	\$1,227,149	\$1,479,049	\$2,025,458	\$3,197,266	\$3,692,266
Finish Grading, Seeding and Paving (5%)	\$623,188	\$895,508	\$1,006,008	\$297,475	\$557,795	\$672,295	\$920,663	\$1,453,303	\$1,678,303
Dewatering	\$200,000	\$200,000	\$200,000	\$200,000	\$0	\$0	\$400,000	\$200,000	\$200,000
Estimated Site Fill ⁽³⁾	\$1,300,000	\$1,300,000	\$1,300,000	\$0	\$0	\$0	\$1,300,000	\$1,300,000	\$1,300,000
Deep Foundations ⁽⁴⁾	\$3,032,250	\$3,750,850	\$3,890,850	\$2,396,500	\$3,115,100	\$3,255,100	\$5,428,750	\$6,865,950	\$7,145,950
Excess Flow Holding Basin (2 MG)	\$2,500,000	\$2,500,000	\$2,500,000	\$0	\$0	\$0	\$2,500,000	\$2,500,000	\$2,500,000
Subtotal	\$23,982,950	\$32,108,654	\$35,254,254	\$10,687,820	\$18,287,124	\$21,541,524	\$34,670,770	\$50,395,778	\$56,795,778
Adder - PS 50 Reroute Gravity Interceptor ⁽⁵⁾	\$3,670,000	\$3,670,000	\$3,670,000	-	-	-	\$3,670,000	\$3,670,000	\$3,670,000
Adder - East Site Access Bridge	-	-	-	\$4,110,000	\$4,110,000	\$4,110,000	\$4,110,000	\$4,110,000	\$4,110,000
Subtotal	\$27,653,000	\$35,779,000	\$38,925,000	\$14,798,000	\$22,398,000	\$25,652,000	\$42,451,000	\$58,176,000	\$64,576,000
Contingency (20%)	\$5,530,600	\$7,155,800	\$7,785,000	\$2,959,600	\$4,479,600	\$5,130,400	\$8,490,200	\$11,635,200	\$12,915,200
Engineering (15%)	\$4,147,950	\$5,366,850	\$5,838,750	\$2,219,700	\$3,359,700	\$3,847,800	\$6,367,650	\$8,726,400	\$9,686,400
Reroute Temporary/Permanent Easements ⁽⁶⁾	\$439,000	\$439,000	\$439,000	-	-	-	\$439,000	\$439,000	\$439,000
Total	\$37,770,550	\$48,740,650	\$52,987,750	\$19,977,300	\$30,237,300	\$34,630,200	\$57,747,850	\$78,537,600	\$87,177,600

⁽¹⁾ Assumes PS 70 will be decommissioned for East Site alternative - PS 70 will be connected by gravity to the PS 50 reroute gravity interceptor.

⁽²⁾ Assumes one digester for Phase 1 and two digesters for Phase 2; each digester to provide 30 days of storage; and biosolids will be sent to land fill.

⁽³⁾ Assumes 65,000 CY required for site fill at \$20/CY and no fill required for South Site.

⁽⁴⁾ Assumes deep foundations (driven steel H-piles) will be required at site - to be confirmed by Geotech Evaluation.

⁽⁵⁾ Assumes PS 50 Reroute alignment west of I-435, requiring no interstate crossings. A PS 50 reroute alignment east of I-435 is approximately \$950,000 additional cost prior to EAI and contingency.

⁽⁶⁾ Assumes permanent easement is 30' width (equal to double the avg. depth) at \$0.50/SF and temporary easement is 20' width at \$0.25/SF. Contingency and EAI are not applied to easement costs.



Estimated Annual O&M Summary (Phase 1 and Phase 2)

Annual Costs	Phase 1 (2 MGD)			Phase 2 (4 MGD)		
	BNR	ENR	LOT	BNR	ENR	LOT
Annual Replacement Costs	\$240,000	\$474,000	\$584,000	\$474,000	\$941,000	\$1,159,000
Annual Chemical Costs	\$80,000	\$124,000	\$163,000	\$159,000	\$247,000	\$325,000
Annual Electricity Usage Costs	\$295,000	\$309,000	\$309,000	\$590,000	\$617,000	\$618,000
Total	\$615,000	\$907,000	\$1,056,000	\$1,223,000	\$1,805,000	\$2,102,000



PHASE 1 (2 MGD) BNR

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$17,000	\$29,000	\$17,000	\$86,000	\$115,000
Fine Screen with Washpress (Headworks)	\$27,000	\$45,000	\$27,000	\$135,000	\$180,000
Vortex Grit System (Headworks)	\$29,000	\$49,000	\$29,000	\$146,000	\$195,000
Ovivo Carrousel System - 3 Stage (2 basins)	\$94,000	\$157,000	\$94,000	\$470,000	\$626,500
Secondary Clarifiers	\$44,000	\$73,000	\$44,000	\$218,000	\$290,000
RAS Pumps	\$23,000	\$38,000	\$23,000	\$113,000	\$150,000
WAS Pumps	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000
UV Disinfection Lamps ¹	\$100,000	\$100,000	\$100,000	\$100,000	N/A
Digestion Blowers	\$35,000	\$59,000	\$35,000	\$176,000	\$235,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Sludge Day Tank Mixers	\$6,000	\$10,000	\$6,000	\$30,000	\$40,000
Centrifuge Feed Pump	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Centrifuge	\$68,000	\$113,000	\$68,000	\$338,000	\$450,000
Cake Conveyors	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000
Total	\$489,000	\$755,960	\$489,000	\$2,044,960	

Future Replacement Costs

(Adjusted w/ Inflation)	Present Value	5 YR	10 YR	15 YR	20 YR	
		1.16	1.34	1.56	1.81	
5 Year Equipment Cycle	\$489,000	\$566,885				
10 Year Equipment Cycle	\$755,960		\$1,015,947			
15 Year Equipment Cycle	\$489,000			\$761,846		
20 Year Equipment Cycle	\$2,044,960				\$3,693,425	
Total	\$3,778,920	\$566,885	\$1,015,947	\$761,846	\$3,693,425	
<u>Replacement Acnt. Deposit</u>		<u>Required</u>				
(Includes Interest)			5 YR	10 YR	15 YR	20 YR
			\$566,885	\$1,015,947	\$761,846	\$3,693,425
	Annual Factor	Annual Deposit	Future Replacement Funds			
SFF - 5 yrs	0.1846	\$104,662	\$566,885	\$566,885	\$566,885	\$566,885
SFF - 10 yrs	0.0833	\$37,403		\$449,062	\$202,586	\$202,586
SFF - 15 yrs	0.0499	(\$381)			(\$7,625)	(\$2,062)
SFF - 20 yrs	0.0336	\$98,261				\$2,926,017
Total			\$566,885	\$1,015,947	\$761,846	\$3,693,425

Estimated Additional Annual Replacement Costs

Deposit \$239,945

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		65,448	\$0.75	\$49,086
Polymer ³					\$30,000
Estimated Annual Chemical Costs					\$79,086

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	35	1	35	26,099	24	228,632
Fine Screen with Washpress (Headworks)	3.5	1	3.5	2,610	4	3,811
Vortex Grit System (Headworks)	1.5	1	1.5	1,119	24	9,798
Ovivo - Mixers (Anaerobic)	3.4	4	13.6	10,142	24	88,840
Ovivo - Mixers (Anoxic)	7.6	4	30.4	22,669	24	198,583
Ovivo - Aerators (Aerated)	68.0	2	136	101,415	24	888,397
Secondary Clarifiers	1.0	2	2	1,491	24	13,065
UV Disinfection Lamps						30,660
RAS Pumps	20.0	1	20	14,914	24	130,647
WAS Pumps	10.0	1	10	7,457	4	10,887
Digestion Blowers	125	2	250	186,425	16	1,088,722
TWAS Transfer Pumps	20.0	1	20	14,914	4	21,774
Sludge Day Tank Mixers	10.0	2	20	14,914	18	97,985
Centrifuge Feed Pump	15.0	1	15	11,185	6	24,496
Centrifuge	120.0	1	120	89,484	6	111,676

kW-hrs/year = 2,947,972
\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL \$294,797 \$613,828

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

¹Based upon annual lamp and ballast replacement cost of \$20,000/year

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.5 mg/L.

³30lbs polymer/dry ton at \$2/lb for 480 dry tons/year



PHASE 1 (2 MGD) ENR

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$17,000	\$29,000	\$17,000	\$86,000	\$115,000
Manual Screen (Headworks)	\$1,000	\$2,000	\$1,000	\$5,000	\$6,000
Fine Screen with Washpress (Headworks)	\$27,000	\$45,000	\$27,000	\$135,000	\$180,000
Vortex Grit System (Headworks)	\$29,000	\$49,000	\$29,000	\$146,000	\$195,000
Ovivo Carrousel System - 5 Stage (2 basins)	\$120,000	\$200,000	\$120,000	\$600,000	\$800,000
Secondary Clarifiers	\$44,000	\$73,000	\$44,000	\$218,000	\$290,000
RAS Pumps	\$23,000	\$38,000	\$23,000	\$113,000	\$150,000
WAS Pumps	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000
Tertiary Filters (dN)	\$399,000	\$665,000	\$399,000	\$1,995,000	\$2,660,000
UV Disinfection Lamps ¹	\$100,000	\$100,000	\$100,000	\$100,000	N/A
Digestion Blowers	\$35,000	\$59,000	\$35,000	\$176,000	\$235,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Sludge Day Tank Mixers	\$6,000	\$10,000	\$6,000	\$30,000	\$40,000
Centrifuge Feed Pump	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Centrifuge	\$68,000	\$113,000	\$68,000	\$338,000	\$450,000
Cake Conveyors	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000

Total \$915,000 \$1,465,960 \$915,000 \$4,174,960

Future Replacement Costs

(Adjusted w/ Inflation)

	Present Value	5 YR 1.16	10 YR 1.34	15 YR 1.56	20 YR 1.81
5 Year Equipment Cycle	\$915,000	\$1,060,736			
10 Year Equipment Cycle	\$1,465,960		\$1,970,128		
15 Year Equipment Cycle	\$915,000			\$1,425,540	
20 Year Equipment Cycle	\$4,174,960				\$7,540,442
Total	\$7,470,920	\$1,060,736	\$1,970,128	\$1,425,540	\$7,540,442

Replacement Acnt. Deposit

(Includes Interest)

		5 YR \$1,060,736	10 YR \$1,970,128	15 YR \$1,425,540	20 YR \$7,540,442
	Annual Factor	Annual Deposit	Future Replacement Funds		
SFF - 5 yrs	0.1846	\$195,841	\$1,060,736	\$1,060,736	\$1,060,736
SFF - 10 yrs	0.0833	\$75,744		\$909,392	\$410,255
SFF - 15 yrs	0.0499	(\$2,270)		(\$45,450)	(\$12,294)
SFF - 20 yrs	0.0336	\$204,236			\$6,081,746

Total \$7,470,920 \$1,060,736 \$1,970,128 \$1,425,540 \$7,540,442

Estimated Additional Annual Replacement Costs

Deposit \$473,551

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		97,652	\$0.75	\$73,239
TN Removal - Methanol ³	Gal	36		\$1.50	\$19,913
Polymer ⁴					\$30,000

Estimated Annual Chemical Costs

\$123,152

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	35	1	35	26,099	24	228,632
Manual Screen (Headworks)	2	1	2	1,491	4	2,177
Fine Screen with Washpress (Headworks)	3.5	1	3.5	2,610	4	3,811
Vortex Grit System (Headworks)	1.5	1	1.5	1,119	24	9,798
Ovivo - Mixers (Anaerobic)	3.4	4	13.6	10,142	24	88,840
Ovivo - Mixers (Anoxic)	7.6	4	30.4	22,669	24	198,583
Ovivo - Aerators (Aerated)	68.0	2	136	101,415	24	888,397
Ovivo - Mixers (Post Anoxic)	7.6	2	15.2	11,335	24	99,291
Ovivo - Mixers (Post Aerated)	5.0	1	5	3,728	24	32,662
Secondary Clarifiers	1.0	2	2	1,491	24	13,065
UV Disinfection Lamps						30,660
RAS Pumps	20.0	1	20	14,914	24	130,647
WAS Pumps	10.0	1	10	7,457	4	10,887
Digestion Blowers	125	2	250	186,425	16	1,088,722
TWAS Transfer Pumps	20.0	1	20	14,914	4	21,774
Sludge Day Tank Mixers	10.0	2	20	14,914	18	97,985
Centrifuge Feed Pump	15.0	1	15	11,185	6	24,496
Centrifuge	120.0	1	120	89,484	6	111,676

kW-hrs/year = 3,082,103

\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL

\$308,210

\$904,913

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

¹Based upon annual lamp and ballast replacement cost of \$20,000/year

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.25 mg/L.

³Assumes a carbon source required to reduce NO_x-N from 10 mg/L to 5 mg/L.

⁴30lbs polymer/dry ton at \$2/lb for 480 dry tons/year



PHASE 1 (2 MGD) LOT

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$17,000	\$29,000	\$17,000	\$86,000	\$115,000
Manual Screen (Headworks)	\$1,000	\$2,000	\$1,000	\$5,000	\$6,000
Fine Screen with Washpress (Headworks)	\$27,000	\$45,000	\$27,000	\$135,000	\$180,000
Vortex Grit System (Headworks)	\$29,000	\$49,000	\$29,000	\$146,000	\$195,000
Ovivo Carrousel System - 5 Stage (2 basins)	\$120,000	\$200,000	\$120,000	\$600,000	\$800,000
Secondary Clarifiers	\$44,000	\$73,000	\$44,000	\$218,000	\$290,000
RAS Pumps	\$23,000	\$38,000	\$23,000	\$113,000	\$150,000
WAS Pumps	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000
Tertiary Filters (dN)	\$599,000	\$998,000	\$599,000	\$2,993,000	\$3,990,000
UV Disinfection Lamps ¹	\$100,000	\$100,000	\$100,000	\$100,000	N/A
Digestion Blowers	\$35,000	\$59,000	\$35,000	\$176,000	\$235,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Sludge Day Tank Mixers	\$6,000	\$10,000	\$6,000	\$30,000	\$40,000
Centrifuge Feed Pump	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Centrifuge	\$68,000	\$113,000	\$68,000	\$338,000	\$450,000
Cake Conveyors	\$8,000	\$13,000	\$8,000	\$38,000	\$50,000

Total \$1,115,000 \$1,798,960 \$1,115,000 \$5,172,960

Future Replacement Costs

(Adjusted w/ Inflation)

	Present Value	5 YR	10 YR	15 YR	20 YR
		1.16	1.34	1.56	1.81
5 Year Equipment Cycle	\$1,115,000	\$1,292,591			
10 Year Equipment Cycle	\$1,798,960		\$2,417,652		
15 Year Equipment Cycle	\$1,115,000			\$1,737,134	
20 Year Equipment Cycle	\$5,172,960				\$9,342,941
Total	\$9,201,920	\$1,292,591	\$2,417,652	\$1,737,134	\$9,342,941

Replacement Acnt. Deposit

(Includes Interest)

		Required	5 YR	10 YR	15 YR	20 YR
			\$1,292,591	\$2,417,652	\$1,737,134	\$9,342,941
	Annual Factor	Annual Deposit	Future Replacement Funds			
SFF - 5 yrs	0.1846	\$238,647	\$1,292,591	\$1,292,591	\$1,292,591	\$1,292,591
SFF - 10 yrs	0.0833	\$93,707		\$1,125,061	\$507,550	\$507,550
SFF - 15 yrs	0.0499	(\$3,147)			(\$63,006)	(\$17,043)
SFF - 20 yrs	0.0336	\$253,873				\$7,559,844

Total \$1,292,591 \$2,417,652 \$1,737,134 \$9,342,941

Estimated Additional Annual Replacement Costs

Deposit \$583,081

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		138,882	\$0.75	\$104,161
TN Removal - Methanol ³	Gal	51		\$1.50	\$27,878
Polymer ⁴					\$30,000

Estimated Annual Chemical Costs

\$162,040

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	35	1	35	26,099	24	228,632
Manual Screen (Headworks)	2	1	2	1,491	4	2,177
Fine Screen with Washpress (Headworks)	3.5	1	3.5	2,610	4	3,811
Vortex Grit System (Headworks)	1.5	1	1.5	1,119	24	9,798
Ovivo - Mixers (Anaerobic)	3.4	4	13.6	10,142	24	88,840
Ovivo - Mixers (Anoxic)	7.6	4	30.4	22,669	24	198,583
Ovivo - Aerators (Aerated)	68.0	2	136	101,415	24	888,397
Ovivo - Mixers (Post Anoxic)	7.6	2	15.2	11,335	24	99,291
Ovivo - Mixers (Post Aerated)	5.0	1	5	3,728	24	32,662
Secondary Clarifiers	1.0	2	2	1,491	24	13,065
UV Disinfection Lamps						30,660
RAS Pumps	20.0	1	20	14,914	24	130,647
WAS Pumps	10.0	1	10	7,457	4	10,887
Digestion Blowers	125	2	250	186,425	16	1,088,722
TWAS Transfer Pumps	20.0	1	20	14,914	4	21,774
Sludge Day Tank Mixers	10.0	2	20	14,914	18	97,985
Centrifuge Feed Pump	15.0	1	15	11,185	6	24,496
Centrifuge	120.0	1	120	89,484	6	111,676

kW-hrs/year = 3,082,103

\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL

\$308,210

\$1,053,331

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.15 mg/L.

³Assumes a carbon source required to reduce NO_x-N from 10 mg/L to 3 mg/L.

⁴30lbs polymer/dry ton at \$2/lb for 480 dry tons/year



PHASE 2 (4 MGD) BNR

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$26,000	\$43,000	\$26,000	\$130,000	\$173,000
Manual Screen (Headworks)	\$1,000	\$2,000	\$1,000	\$5,000	\$6,000
Fine Screen with Washpress (Headworks)	\$54,000	\$90,000	\$54,000	\$270,000	\$360,000
Vortex Grit System (Headworks)	\$59,000	\$98,000	\$59,000	\$293,000	\$390,000
Ovivo Carrousel System - 3 Stage (4 basins)	\$188,000	\$313,000	\$188,000	\$940,000	\$1,253,000
Secondary Clarifiers	\$87,000	\$145,000	\$87,000	\$435,000	\$580,000
RAS Pumps	\$45,000	\$75,000	\$45,000	\$225,000	\$300,000
WAS Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
UV Disinfection Lamps ¹	\$200,000	\$200,000	\$200,000	\$200,000	N/A
Digestion Blowers	\$71,000	\$118,000	\$71,000	\$353,000	\$470,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Sludge Day Tank Mixers	\$12,000	\$20,000	\$12,000	\$60,000	\$80,000
Centrifuge Feed Pump	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Centrifuge	\$135,000	\$225,000	\$135,000	\$675,000	\$900,000
Cake Conveyors	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Total	\$968,000	\$1,485,960	\$968,000	\$4,042,960	

Future Replacement Costs

(Adjusted w/ Inflation)

	Present Value	5 YR	10 YR	15 YR	20 YR
		1.16	1.34	1.56	1.81
5 Year Equipment Cycle	\$968,000	\$1,122,177			
10 Year Equipment Cycle	\$1,485,960		\$1,997,006		
15 Year Equipment Cycle	\$968,000			\$1,508,112	
20 Year Equipment Cycle	\$4,042,960				\$7,302,035
Total	\$7,464,920	\$1,122,177	\$1,997,006	\$1,508,112	\$7,302,035

Replacement Acnt. Deposit

(Includes Interest)

		5 YR	10 YR	15 YR	20 YR
		\$1,122,177	\$1,997,006	\$1,508,112	\$7,302,035
	Annual Factor	Annual Deposit	Future Replacement Funds		
SFF - 5 yrs	0.1846	\$207,184	\$1,122,177	\$1,122,177	\$1,122,177
SFF - 10 yrs	0.0833	\$72,865		\$874,829	\$394,662
SFF - 15 yrs	0.0499	(\$436)		(\$8,727)	(\$2,361)
SFF - 20 yrs	0.0336	\$194,356			\$5,787,557
Total			\$1,122,177	\$1,997,006	\$1,508,112
Estimated Additional Annual Replacement Costs	Deposit	\$473,970			

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		130,896	\$0.75	\$98,172
Polymer ³					\$60,000
Estimated Annual Chemical Costs					\$158,172

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	70	1	70	52,199	24	457,263
Fine Screen with Washpress (Headworks)	7	1	7	5,220	4	7,621
Vortex Grit System (Headworks)	3	1	3	2,237	24	19,597
Ovivo - Mixers (Anaerobic)	6.8	4	27.2	20,283	24	177,679
Ovivo - Mixers (Anoxic)	15.2	4	60.8	45,339	24	397,166
Ovivo - Aerators (Aerated)	136	2	272	202,830	24	1,776,794
Secondary Clarifiers	2	2	4	2,983	24	26,129
UV Disinfection Lamps						61,320
RAS Pumps	40	1	40	29,828	24	261,293
WAS Pumps	20	1	20	14,914	4	21,774
Digestion Blowers	250	2	500	372,850	16	2,177,444
TWAS Transfer Pumps	40	1	40	29,828	4	43,549
Sludge Day Tank Mixers	20	2	40	29,828	18	195,970
Centrifuge Feed Pump	30	1	30	22,371	6	48,992
Centrifuge	240	1	240	178,968	6	223,352

kW-hrs/year = 5,895,944
\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL

\$589,594
\$1,221,736

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

¹Based upon annual lamp and ballast replacement cost of \$40,000/year

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.5 mg/L.

³30lbs polymer/dry ton at \$2/lb for 960 dry tons/year



PHASE 2 (4 MGD) ENR

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$26,000	\$43,000	\$26,000	\$130,000	\$173,000
Manual Screen (Headworks)	\$1,000	\$2,000	\$1,000	\$5,000	\$6,000
Fine Screen with Washpress (Headworks)	\$54,000	\$90,000	\$54,000	\$270,000	\$360,000
Vortex Grit System (Headworks)	\$59,000	\$98,000	\$59,000	\$293,000	\$390,000
Ovivo Carrousel System - 5 Stage (2 basins)	\$240,000	\$400,000	\$240,000	\$1,200,000	\$1,600,000
Secondary Clarifiers	\$87,000	\$145,000	\$87,000	\$435,000	\$580,000
RAS Pumps	\$45,000	\$75,000	\$45,000	\$225,000	\$300,000
WAS Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Tertiary Filters (dN)	\$798,000	\$1,330,000	\$798,000	\$3,990,000	\$5,320,000
UV Disinfection Lamps ¹	\$200,000	\$200,000	\$200,000	\$200,000	N/A
Digestion Blowers	\$71,000	\$118,000	\$71,000	\$353,000	\$470,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Sludge Day Tank Mixers	\$12,000	\$20,000	\$12,000	\$60,000	\$80,000
Centrifuge Feed Pump	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Centrifuge	\$135,000	\$225,000	\$135,000	\$675,000	\$900,000
Cake Conveyors	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Total	\$1,818,000	\$2,902,960	\$1,818,000	\$8,292,960	

Future Replacement Costs

(Adjusted w/ Inflation)

	Present Value	5 YR	10 YR	15 YR	20 YR
		1.16	1.34	1.56	1.81
5 Year Equipment Cycle	\$1,818,000	\$2,107,560			
10 Year Equipment Cycle	\$2,902,960		\$3,901,335		
15 Year Equipment Cycle	\$1,818,000			\$2,832,385	
20 Year Equipment Cycle	\$8,292,960				\$14,978,008
Total	\$14,831,920	\$2,107,560	\$3,901,335	\$2,832,385	\$14,978,008

Replacement Acnt. Deposit

(Includes Interest)

		Required	5 YR	10 YR	15 YR	20 YR
			\$2,107,560	\$3,901,335	\$2,832,385	\$14,978,008
	Annual Factor	Annual Deposit	Future Replacement Funds			
SFF - 5 yrs	0.1846	\$389,113	\$2,107,560	\$2,107,560	\$2,107,560	\$2,107,560
SFF - 10 yrs	0.0833	\$149,405		\$1,793,775	\$809,227	\$809,227
SFF - 15 yrs	0.0499	(\$4,215)			(\$84,402)	(\$22,831)
SFF - 20 yrs	0.0336	\$405,804				\$12,084,052
Total			\$2,107,560	\$3,901,335	\$2,832,385	\$14,978,008

Estimated Additional Annual Replacement Costs

Deposit \$940,106

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		195,303	\$0.75	\$146,478
TN Removal - Methanol ³	Gal	73		\$1.50	\$39,826
Polymer ⁴					\$60,000

Estimated Annual Chemical Costs

\$246,304

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	70	1	70	52,199	24	457,263
Manual Screen (Headworks)	4	1	4	2,983	4	4,355
Fine Screen with Washpress (Headworks)	7	1	7	5,220	4	7,621
Vortex Grit System (Headworks)	3	1	3	2,237	24	19,597
Ovivo - Mixers (Anaerobic)	6.8	4	27.2	20,283	24	177,679
Ovivo - Mixers (Anoxic)	15.2	4	60.8	45,339	24	397,166
Ovivo - Aerators (Aerated)	136	2	272	202,830	24	1,776,794
Ovivo - Mixers (Post Anoxic)	15.2	2	30.4	22,669	24	198,583
Ovivo - Mixers (Post Aerated)	10	1	10	7,457	24	65,323
Secondary Clarifiers	2	2	4	2,983	24	26,129
UV Disinfection Lamps						61,320
RAS Pumps	40	1	40	29,828	24	261,293
WAS Pumps	20	1	20	14,914	4	21,774
Digestion Blowers	250	2	500	372,850	16	2,177,444
TWAS Transfer Pumps	40	1	40	29,828	4	43,549
Sludge Day Tank Mixers	20	2	40	29,828	18	195,970
Centrifuge Feed Pump	30	1	30	22,371	6	48,992
Centrifuge	240	1	240	178,968	6	223,352

kW-hrs/year = 6,164,205

\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL

\$616,421

\$1,802,831

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

¹Based upon annual lamp and ballast replacement cost of \$40,000/year

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.25 mg/L.

³Assumes a carbon source required to reduce NO_x-N from 10 mg/L to 5 mg/L.

⁴30lbs polymer/dry ton at \$2/lb for 960 dry tons/year



PHASE 2 (4 MGD) LOT

Replacement Costs

Inflation Rate	3%	Assumed
Interest Rate	4%	Assumed

Today's Replacement Costs

Item	5 YR	10 YR	15 YR	20 YR	Original Equipment Cost
	15%	25%	15%	75%	
Influent Pumps	\$26,000	\$43,000	\$26,000	\$130,000	\$173,000
Manual Screen (Headworks)	\$1,000	\$2,000	\$1,000	\$5,000	\$6,000
Fine Screen with Washpress (Headworks)	\$54,000	\$90,000	\$54,000	\$270,000	\$360,000
Vortex Grit System (Headworks)	\$59,000	\$98,000	\$59,000	\$293,000	\$390,000
Ovivo Carrousel System - 5 Stage (2 basins)	\$240,000	\$400,000	\$240,000	\$1,200,000	\$1,600,000
Secondary Clarifiers	\$87,000	\$145,000	\$87,000	\$435,000	\$580,000
RAS Pumps	\$45,000	\$75,000	\$45,000	\$225,000	\$300,000
WAS Pumps	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Tertiary Filters (dN)	\$1,197,000	\$1,995,000	\$1,197,000	\$5,985,000	\$7,980,000
UV Disinfection Lamps ¹	\$200,000	\$200,000	\$200,000	\$200,000	N/A
Digestion Blowers	\$71,000	\$118,000	\$71,000	\$353,000	\$470,000
Diffusers	\$0	\$6,960	\$0	\$6,960	N/A
TWAS Transfer Pumps	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Sludge Day Tank Mixers	\$12,000	\$20,000	\$12,000	\$60,000	\$80,000
Centrifuge Feed Pump	\$30,000	\$50,000	\$30,000	\$150,000	\$200,000
Centrifuge	\$135,000	\$225,000	\$135,000	\$675,000	\$900,000
Cake Conveyors	\$15,000	\$25,000	\$15,000	\$75,000	\$100,000
Total	\$2,217,000	\$3,567,960	\$2,217,000	\$10,287,960	

Future Replacement Costs

(Adjusted w/ Inflation)

	Present Value	5 YR	10 YR	15 YR	20 YR
		1.16	1.34	1.56	1.81
5 Year Equipment Cycle	\$2,217,000	\$2,570,111			
10 Year Equipment Cycle	\$3,567,960		\$4,795,040		
15 Year Equipment Cycle	\$2,217,000			\$3,454,014	
20 Year Equipment Cycle	\$10,287,960				\$18,581,200
Total	\$18,289,920	\$2,570,111	\$4,795,040	\$3,454,014	\$18,581,200

Replacement Acnt. Deposit

(Includes Interest)

		Required	5 YR	10 YR	15 YR	20 YR
			\$2,570,111	\$4,795,040	\$3,454,014	\$18,581,200
	Annual Factor	Annual Deposit	Future Replacement Funds			
SFF - 5 yrs	0.1846	\$474,512	\$2,570,111	\$2,570,111	\$2,570,111	\$2,570,111
SFF - 10 yrs	0.0833	\$185,316		\$2,224,929	\$1,003,734	\$1,003,734
SFF - 15 yrs	0.0499	(\$5,984)			(\$119,831)	(\$32,414)
SFF - 20 yrs	0.0336	\$505,062				\$15,039,770

Total			\$2,570,111	\$4,795,040	\$3,454,014	\$18,581,200
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Estimated Additional Annual Replacement Costs

Deposit \$1,158,906

Chemical Costs @ ADF

Component		Units Per Day	Units Per Year	Cost Per Unit	Cost
TP Removal - Alum ²	Gal		277,764	\$0.75	\$208,323
TN Removal - Methanol ³	Gal	102		\$1.50	\$55,757
Polymer ⁴					\$60,000

Estimated Annual Chemical Costs

\$324,079

Electricity Usage Costs (@ ADF)

Component	HP	Quantity	Total HP	Watts	Hours/day	kW-hrs/year
Influent Pumps	70	1	70	52,199	24	457,263
Manual Screen (Headworks)	4	1	4	2,983	4	4,355
Fine Screen with Washpress (Headworks)	7	1	7	5,220	4	7,621
Vortex Grit System (Headworks)	3	1	3	2,237	24	19,597
Ovivo - Mixers (Anaerobic)	6.8	4	27.2	20,283	24	177,679
Ovivo - Mixers (Anoxic)	15.2	4	60.8	45,339	24	397,166
Ovivo - Aerators (Aerated)	136	2	272	202,830	24	1,776,794
Ovivo - Mixers (Post Anoxic)	15.2	2	30.4	22,669	24	198,583
Ovivo - Mixers (Post Aerated)	10	1	10	7,457	24	65,323
Secondary Clarifiers	2	2	4	2,983	24	26,129
UV Disinfection Lamps						61,320
RAS Pumps	40	1	40	29,828	24	261,293
WAS Pumps	20	1	20	14,914	4	21,774
Digestion Blowers	250	2	500	372,850	16	2,177,444
TWAS Transfer Pumps	40	1	40	29,828	4	43,549
Sludge Day Tank Mixers	20	2	40	29,828	18	195,970
Centrifuge Feed Pump	30	1	30	22,371	6	48,992
Centrifuge	240	1	240	178,968	6	223,352

kW-hrs/year = 6,164,205

\$/kW-hrs = \$0.10

Estimated Annual Electricity Usage Costs (@ ADF for Secondary Treatment)

TOTAL

\$617,839

\$2,100,824

Notes:

Items Not Included = Potable Water, Building Heating, HVAC Requirements

¹Based upon annual lamp and ballast replacement cost of \$40,000/year

²Assumes a chemical trimming of PO₄-P from 3.5 mg/L to 0.15 mg/L.

³Assumes a carbon source required to reduce NO_x-N from 10 mg/L to 3 mg/L.

⁴30lbs polymer/dry ton at \$2/lb for 960 dry tons/year