



City of La Crosse

2040 Wastewater Strategic Plan | Treatment Facility

May 28, 2019

La Crosse Wastewater Treatment Facility
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La Crosse, WI 54601

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ABBREVIATIONS

7-d	Seven-day
30-d	Thirty-day
AA	Annual Average
ac	acres
ACH	Air Changers per Hour
BOD	5-day Biochemical Oxygen Demand
BFP	Belt Filter Press
CID1	Class I, Division 1
CID2	Class 1, Division 2
CFR	Code of Federal Regulations
City	City of La Crosse
CWFP	Clean Water Fund Program
CMOM	Capacity, Management, Operation, and Maintenance
cy	cubic yards
cyh	cubic yards per hour
d	day
DOA	Department of Administration
DSD	Digested Sludge
DT	dry tons
EPA	United States Environmental Protection Agency
EQ	Exceptional Quality (biosolids)
Facility	Facility
F:M	food-to-microorganism ratio
ft	feet
GBT	Gravity Belt Thickener
gpcd	gallons per capita per day
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
H ₂ S	Hydrogen Sulfide
hp	horsepower
hr/d	hours per day
HVAC	Heating, Ventilation, and Air Conditioning
in	inches
in/hr	inches per hour
kcf	thousand cubic feet
Kg	kilogram
kWh	kilowatt hours
lbs	pounds
M	millions
MCC	Motor Control Center
MD	Maximum Day
mg	milligram
mg/L	milligrams per liter
mgal	million gallons

ABBREVIATIONS (CONTINUED)

mgd	million gallons per day
ML	mixed liquor
MM	Maximum Month
mo	month
MPN	most probable number
MRRPC	Mississippi River Regional Planning Commission
MW	Maximum Week
NFPA	National Fire Protection Agency
NR	Natural Resources
Permit	WPDES Permit
P	phosphorus
PP	particulate phosphorus
ppcd	pounds per capita per day
ppd	pounds per day
ppy	pounds per year
ng/L	nanograms per liter
Q	refers to flow
RAS	Return Activated Sludge
RWW	Raw Wastewater
scfm	Standard Cubic Feet per Minute
sf	square feet
SNRP	soluble non-reactive phosphorus
SP	soluble phosphorus
SRP	soluble reactive phosphorus
SRT	Solids Retention Time or sludge age
SSES	Sewer System Evaluation Survey
SSO	Sanitary Sewer Overflow
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPAD	Temperature Phased Anaerobic Digestion
TS	Total Solids
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
USEPA	United States Environmental Protection Agency
VS	Volatile Solids
VSS	Volatile Suspended Solids
WAC	Wisconsin Administrative Code
WAS	Waste Activated Sludge
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollution Discharge Elimination System
WWTF	Wastewater Treatment Facility
yr	year

EXECUTIVE SUMMARY

PURPOSE

This Report documents Wastewater Treatment Strategic Planning. This Planning effort, which was initiated in 2015, produced a comprehensive Recommended Plan (Plan): a capital improvement program to provide the City a safe, reliable, cost-effective, and Permit-compliant wastewater treatment system for the nominal 20-year planning period. The Plan addresses concerns as categorized below, and provided in more detail in TM 1 Project Definition. The final year of the nominal 20-year planning period is Year 2040.

1. Capacity deficiency
2. Regulatory compliance
3. Resource Recovery
4. Environmental Stewardship
5. Public Safety
6. Aging Infrastructure

CAPACITY DEFICIENCY

As loadings to the Facility increased, the limiting unit process was identified as the solids system. Solids system components lack adequate capacity today and are anticipated to further lack capacity during the 20-year planning period. The Recommended Plan addresses capacity concerns for the City and regional communities.

REGULATORY COMPLIANCE

The Recommended Plan addresses compliance concerns. Recommendations aimed at maintaining compliance with present-day regulatory requirements are categorized as Aging Infrastructure recommendations. The Regulatory Compliance recommendations are aimed at impending regulations, namely a lower effluent phosphorus limit as defined by a water quality based effluent limit (WQBEL) and land application restrictions for phosphorus in biosolids.

RESOURCE RECOVERY

A wastewater facility receives nutrients such as nitrogen and phosphorus every day it is operable. These nutrients can be recovered and recycled to other end uses. For example, biosolids disposal options are affected by the level of biosolids treatment therefore impacting the available end users. Alternatives that improve resource recovery and the ability to recycle nutrients for another sector will be ranked higher. An alternative that enhances resource recovery improves the environment and can boost public perception.

Another area of resource recovery is creating beneficial uses for the various products from the WWTP. These include water reuse, biogas utilization, heat recovery, and biosolids end-use. Although some of these recovery products are currently partially captured, enhancements will align with the City's strategic goals.

ENVIRONMENTAL STEWARDSHIP

Protection of community assets such as the Mississippi River and reducing carbon footprint for the City is a priority concern. The Facility is well operated and maintained; however, some of the unit processes in the liquid and solids treatment trains lack adequate reliability, flexibility, redundancy, and control. These shortcomings degrade the potential performance of the Facility and jeopardize consistent, reliable compliance.

Minimizing energy use not only provides savings on cost, but it also minimizes the impact to the environment. Some alternatives may even produce new sources of energy that could be used at the facility and offset existing energy reliance. Public perception of the WWTP can be impacted by the facility's use of energy. Alternatives that positively contribute to reducing total net energy use will be more desirable.

PUBLIC SAFETY

Protection of City staff and the community are vital to the success of the current Facility. During the previous facility plan assessment, code related improvements for National Fire Protection Association (NFPA) and 10-States Standards were identified as important standards to uphold in any future improvements project. The Facility, most of which was designed and constructed before NFPA 820 was adopted, does not comply with this Standard.

AGING INFRASTRUCTURE

The Recommended Plan addresses safety, reliability, and performance concerns. The Facility was constructed in two major phases: Phase 1 in 1936, Phase 2 in 1972, since then several replacement projects have continued to advance the facility. Much of the core infrastructure and equipment is at least 47 years old. Structural infrastructure remaining from the Phase 1 facility is now 83 years old and may be nearing the end of its useful life. A significant fraction of the equipment installed in 1972 has been well maintained, but is also rapidly approaching the end of its reliable service life.

CURRENT FLOWS AND LOADINGS

Existing service area populations are provided in Table 1. The service area serves residential populations of La Crosse, Onalaska, T. Campbell, T. Shelby in Wisconsin and La Crescent, Minnesota. It also serves significant industrial users within the City of La Crosse. TM 2 – Existing Conditions provides additional detail about each unit process and the current flows and loadings.

Table 1 - Existing Flow and Loading Summary

	Average	Max. Month	Max. Week	Max. Day	Peak Hourly
Sewer Service Area Population = 90,955					
Flow (MGD)	10.07	11.94	13.15	17.9	32.3
BOD (lb/d)	25,975	29,400	35,200	64,000	
TSS (lb/d)	29,529	48,900	60,900	100,000	
TP (lb/d)	548	675	800	1,500	

FUTURE FLOWS AND LOADINGS

Future residential contributions were projected using population estimates, while industrial contributions were projected from feedback received from the major industries. TM 3 – Future Conditions provides additional detail about the projection methodology. Design wastewater flows and loadings are estimated by adding together the future municipal load and future industrial load and are presented in Table 2.

Table 2 - 2040 Design Flow and Loading Summary

	Average	Max. Month	Max. Week	Max. Day	Peak Hourly
Sewer Service Area Population = 99,911					
Flow (MGD)	12.99	13.26	14.88	21.24	42.5
BOD (lb/d)	30,000	27,200	32,600	59,250	
TSS (lb/d)	33,300	66,200	82,500	135,500	
TP (lb/d)	590	860	1,020	1,900	

ALTERNATIVES ANALYSIS

The Recommended Plan is a product of an evaluation of alternatives that address present-day and design-year issues and concerns, these items are summarized in TM 4 – System Needs. The alternatives that address these shortcomings have been grouped into the four key issue categories listed and defined in Table 3. Many of the alternatives, particularly those that address safety-, condition-, and/or performance-related issues, do not have a competing alternative or alternatives. Alternatives that do not have a competing alternative remedy shortcomings in a straightforward and cost-effective manner consistent with the present-day Facility configuration, leveraging to the maximum extent possible previous infrastructure investments.

Table 3 - Key Issue Categories

Issue Categories	Definition
Reliability	Some of these alternatives remedy safety-, condition-, or age-related deficiencies associated with process equipment, equipment ancillary to processes, process-related infrastructure, and Facility-related infrastructure. Other alternatives enhance the performance, stability, reliability, and/or efficiency of a particular unit process.
Solids Capacity	These alternatives enhance the solids capacity of a particular unit process to adequately and efficiently accommodate projected Design Year flows and loadings.
Phosphorus Regulations	These alternatives enhance existing unit processes, replace existing unit processes, or add unit processes to comply with more stringent future regulations. For this Plan, these alternatives were aimed exclusively at phosphorus compliance. The Facility discharges to a stretch of the Mississippi River that is phosphorus impaired and the effluent has been assigned a maximum effluent phosphorus concentration of 0.1 mg/L TP.
Energy	These alternatives provide options to minimize the City's carbon footprint by boosting digester biogas, capturing this methane and processing the gas to generate renewable energy or fuel.

PROCESS ISSUES AND CONCERNS

Process issues and concerns are pervasive throughout the aging Facility. These are delineated in Chapters 3 and 4 and are summarized in Table 4. Figure 1 shows required solids handling unit process capacities relative to the current rated capacity. Bars that fall short of the horizontal 100% line lack adequate capacity. Proposed modifications were brainstormed as alternatives and selected for further evaluation in TM 5 – Alternative Screening and Retained Alternatives.

NON-PROCESS ISSUES AND CONCERNS

Non-process issues and concerns are pervasive throughout the aging Facility. These are delineated in Chapters 3 and 4. In general, non-process issues and concerns are related to aging Buildings, aging Site features and infrastructure, and changed or more restrictive safety Standards, building Codes, and workplace requirements.

ALTERNATIVE COMPARTMENTS

Alternatives were grouped in the Alternative Compartments listed below. Table 4 shows how the alternatives were assembled by each unit process and by key issues and concerns.

1. Preliminary Treatment
2. Primary Clarification
3. Activated Sludge
4. Effluent Phosphorus
5. Disinfection
6. Sludge Thickening
7. Digestion
8. Biosolids Reuse
9. Biogas Utilization
10. Site and Utilities

Table 4 - Summary of Existing Unit Process Issues and Concerns

Unit Process	Reliability	Capacity	Phosphorus Regulations	Energy
Preliminary Treatment				
Fine Screen	■	■		
Influent Pumping				
Grit Removal and Influent Flow Measurement	■			
Hauled Waste Receiving	■			
Primary Clarification				
Primary Settling		■		
Scum and Sludge Handling	■			■
Activated Sludge				
Activated Sludge Reactors	■		■	
Aeration Blowers and Diffusers				■
Secondary Settling	■			
Return Activated Sludge Handling	■			
Effluent Phosphorus				
Effluent Filtration			■	
Disinfection				
Ultraviolet Light System	■			
Sludge Thickening				
Pre-Digestion Sludge Thickening		■		■
Digestion				
Anaerobic Digestion Heating and Mixing	■	■		■
Biosolids Reuse				
Biosolids Storage	■	■		
Land Application Program	■		■	
Biogas Utilization				
Gas Safety Equipment	■			
Digester Boilers	■			■
Site and Utilities				
Building Heating System	■			■
Compliance with Code and Standards	■			
Effluent Water Reuse	■	■		
Electrical Infrastructure	■			
Flood Management	■			
Odor and Corrosion Control	■			

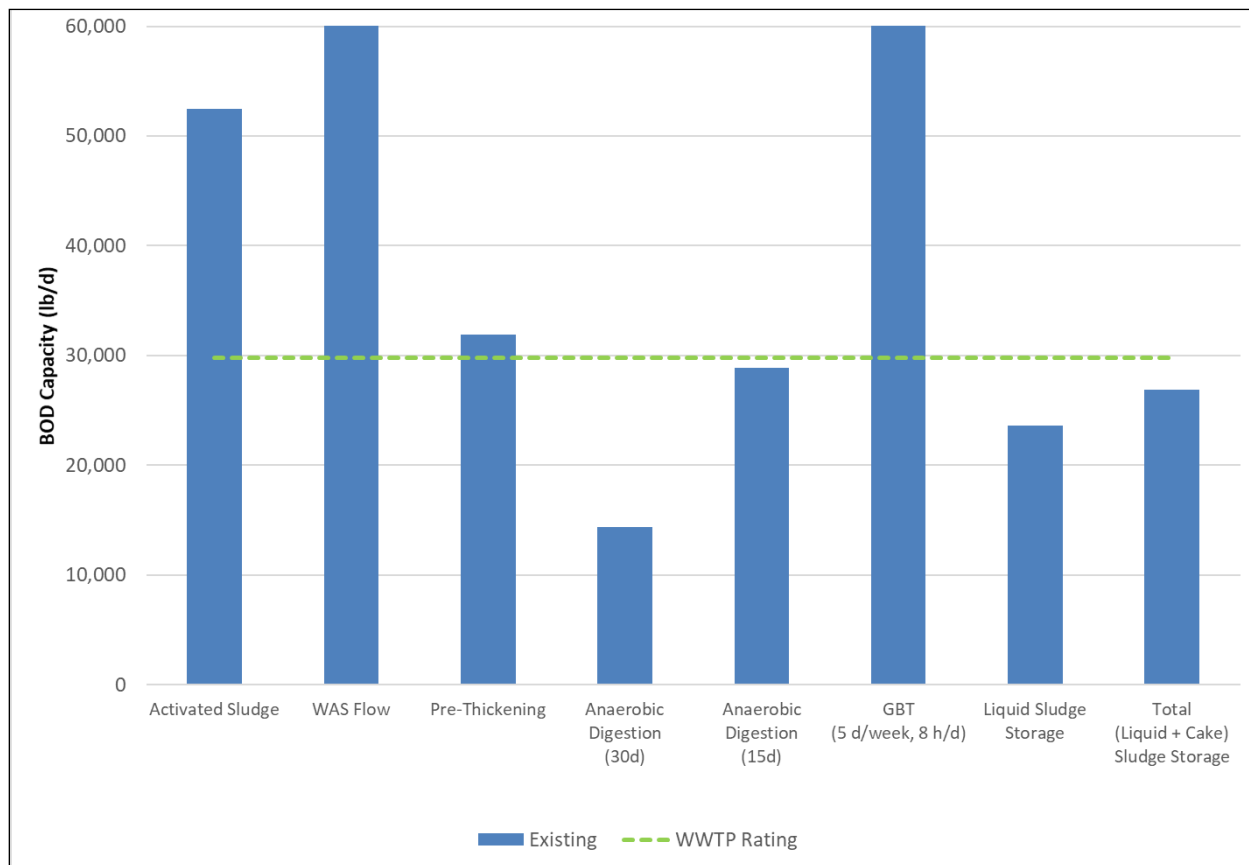


Figure 1-1 Existing Solids Handling Unit Process Capacities Relative to Required Capacities

COST ALLOCATION

Elected officials and the rate paying stakeholders deserve a clear and succinct explanation of the issues and concerns proposed capital improvements address.

OPINIONS OF COST

Detailed planning phase capital cost opinions are included in Appendix 6A. Annual cost opinions were developed when two competing alternatives have different annual operating costs. The annual costs are converted to a 20-year present worth cost. The 20-year present worth represents the current dollars required to construct the improvements and operate them for 20 years.

RESIDENTIAL USER COST PERSPECTIVE

In addition to considering capital, annual, and total present worth costs, the Plan was developed considering typical City of La Crosse residential rate increases. The City intends to finance the project using the Clean Water Fund (CWF) over a 20-year term (1.98% annual interest rate).

THE ANALYSIS OF ALTERNATIVES

The details of the Alternatives Analysis are beyond the scope of an Executive Summary. The rationale used to recommend or select specific alternatives are documented in TM 6 – Alternatives Analysis.

RECOMMENDED PLAN

The Recommended Plan is the collection of individual recommendations for the various unit processes and Facility functions. Figure 2 shows how costs are distributed around the Facility and between the condition categories. A summary of the recommended plan project components is provided in TM 7 – Recommended Plan, with a total capital cost of \$50M. Typical City of La Crosse residential user rates will increase approximately \$5.87/month if the Project is financed using a 20-year Wisconsin Clean Water Fund Program low-interest loan.

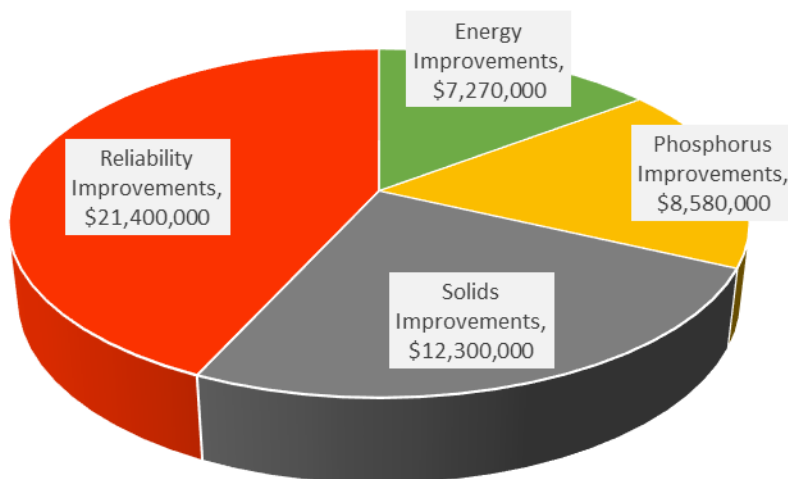


Figure 2 - Capital Cost Distribution by Condition Category

Figure 2 shows that the Recommended Plan is first and foremost a capital improvement plan to address safety, reliability, and performance concerns at an aging Facility. More than 40% of the total capital cost is attributed to reliability-, safety-, and performance-related improvements. Roughly 25% of the total capital cost addresses capacity concerns for the solids handling processes and 17% of the total capital cost is to implement a simple, reliable, and robust strategy to comply with an impending low-level effluent phosphorus limit. The City continues to explore all potential methods to minimize this cost; however, the included alternative provides a simple method to comply with the current stringent limit. The Recommended Plan also includes a biosolids drying process that will produce a Class A EQ biosolids end product, eliminating the challenges inherent with the existing Class B land application program and guarding against future challenges that could significantly increase the annual cost of the current program. Lastly, 15% of the Plan provides energy improvements that increase biogas quantities and combust treated biogas in a cogeneration reciprocating engine-generator to produce electricity.

The City intends to Bid the Work associated with the proposed Facility improvements in the first quarter of 2021. Construction is expected to require 24 months. A proposed implementation schedule is shown in Figure 3. In conformance with the requirements of the Wisconsin Clean Water Fund Program, reviewable plans and specifications will be submitted to the WDNR by September 30, 2019.

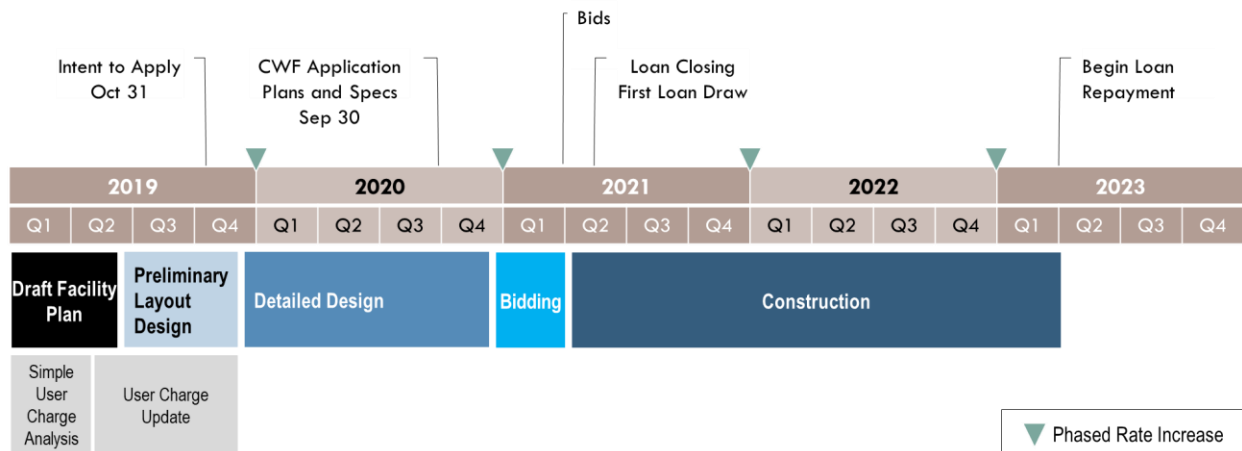


Figure 3 - Proposed Implementation Schedule for the Recommended Plan

Technical Memorandum 1
Project Definition
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTP Superintendent
Brian Hein – WWTP Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
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Purpose

The purpose of Technical Memorandum 1 (TM 1) is to establish the project definition for the La Crosse Wastewater Facility (WWTP) Facilities Plan which will set the strategic direction of the facility's future. TM 1 documents major points of discussion that occurred at the Kickoff Workshop held on August 15, 2018. This TM also serves to establish the following planning foundations for the Facilities Plan:

- Project Drivers
- Planning goals and objectives
- Stakeholders and level of involvement
- Metrics for evaluating improvement alternatives

Project Drivers

Several Project Drivers were identified at the Kickoff Workshop. These drivers provide motivation and justification for the Facilities Plan. The Project Drivers are described below:

Capacity Deficiency	Ensuring adequate capacity for the City and regional communities
Regulatory Compliance	Planning for compliance with future regulations with an emphasis on phosphorus limits and biosolids management
Resource Recovery	Reusing and recycling valuable resources from the various waste streams and processes
Environmental Stewardship	Protecting community assets such as Mississippi River and reducing carbon footprint for City as a whole
Public Safety	Protecting the community and City staff
Aging Infrastructure	Renewing and maintaining facilities to provide reliable service and treatment performance

Project Phases

This planning project has eight phases of work.

Phase 1 Project Definition	Establish strategic direction, project objectives, metrics for evaluations, and decision-making criteria
Phase 2 Existing Conditions	Document current condition of facilities, flows, loadings, and performance
Phase 3 Future Conditions	Define future conditions required by the facility during the planning period. This will include a review of flows, loadings, and impacts from future regulations and trends inclusive of significant industrial loading scenarios.
Phase 4 System Needs	Summarize deficiencies to be addressed in the planning period and preliminary prioritize
Phase 5 Retained Alternatives	Identify and screen alternatives to address system needs
Phase 6 Evaluate Alternatives	Develop, evaluate, and compare alternatives that resolve system needs
Phase 7 Recommended Plan	Document rationale for technical solutions and timing for implementation as well as estimate user rate impacts
Phase 8 Facilities Plan Amendment	Prepare summary report for quick representation of Phases 1 through 7, conduct public meetings, and submit for regulatory approval.

Project Goals and Objectives

The Facilities Plan will provide evaluations focused on the WWTP, collection system, and watershed. Project alternatives will be developed for both the liquid treatment and solids treatment areas of the facility. These alternatives will be evaluated holistically with economic and non-economic criteria. The finalized Plan will recommend improvements to the facilities with recommended phases and an implementation schedule to meet the needs identified in the Existing and Future Conditions phase.

The alternatives evaluation portion TM 6 will be refined and submitted separately to satisfy the WDNR required Preliminary Compliance Alternatives Plan.

Mission Statement

Overall, the Facility Plan will be guided by the following mission statement:

The Facility Plan establishes a course of action that emphasizes optimum performance, sustainability, and resource recovery to direct the WWTP through regulation while ensuring continued protection of local resources and the environment.

Project Stakeholders

Major project stake holders were identified at the Strategic Direction Workshop. Understanding the stakeholders will help guide project update and input stages and help to establish a decision-making process. The following list summarizes the project stakeholders:

- City Sewer Customers

- Major Commercial and Industrial Customers
 - City Brewery
 - Kwik Trip Dairy
 - Great Lakes Cheese
 - Trane Company
- Partner Municipalities
 - City of Onalaska
 - City of La Crescent, MN
 - Town of Campbell
 - Town of Shelby Sanitary District 1
 - Town of Shelby Sanitary District 2

Evaluation Criteria

The evaluation process will be driven by both economic and non-economic factors. During the Kickoff Workshop these drivers were discussed and refined. The alternative analysis will develop materials related to each of these factors for comparison and evaluation.

The economic analysis and non-economic analysis will be performed in parallel. Alternatives will be evaluated based on how well they balance both cost as well as non-economic criteria. User rate and 20-year life cycle costs will be used to quantify the economics, and a scoring matrix will be used to quantify the non-economic criteria.

Economic Evaluation

The economic evaluation will include both a life-cycle analysis as well as a simple user rate comparison.

Life-cycle Evaluation

A life-cycle economic evaluation will be developed for each alternative to understand the holistic cost. The following discount, inflation, and escalation rates were identified based on current economic data and will be used to develop life-cycle costs.

Parameter	Value
Discount Rate	3.625% ¹

1. WDNR Guidance in accordance with NR 110.09(1)(a)

Initial unit electricity costs will be based on 2017 electric bills. Natural gas unit costs will be based on 2017 natural gas bills. The unit energy costs are listed below.

Parameter	Value
Electricity	\$0.083 per kWh
Natural Gas	\$0.65 per Therm

Economic evaluations will summarize Capital Costs and Annual Costs. Based on the Capital and Annual Cost, the Net Present Value (NPV) of each alternatives will be captured to represent the life-cycle costs. The Facilities Plan will summarize life-cycle costs similar to the graphic shown in Figure 1. Year "0" costs represent the estimated capital costs for construction and Year "20" costs on the right-hand side represent the net present value at the end of the 20-year planning period (i.e. the present value of the

life cycle costs). The slope of the line is defined by the annual operation and maintenance (O&M) costs. Steeper slopes represent higher annual O&M costs.

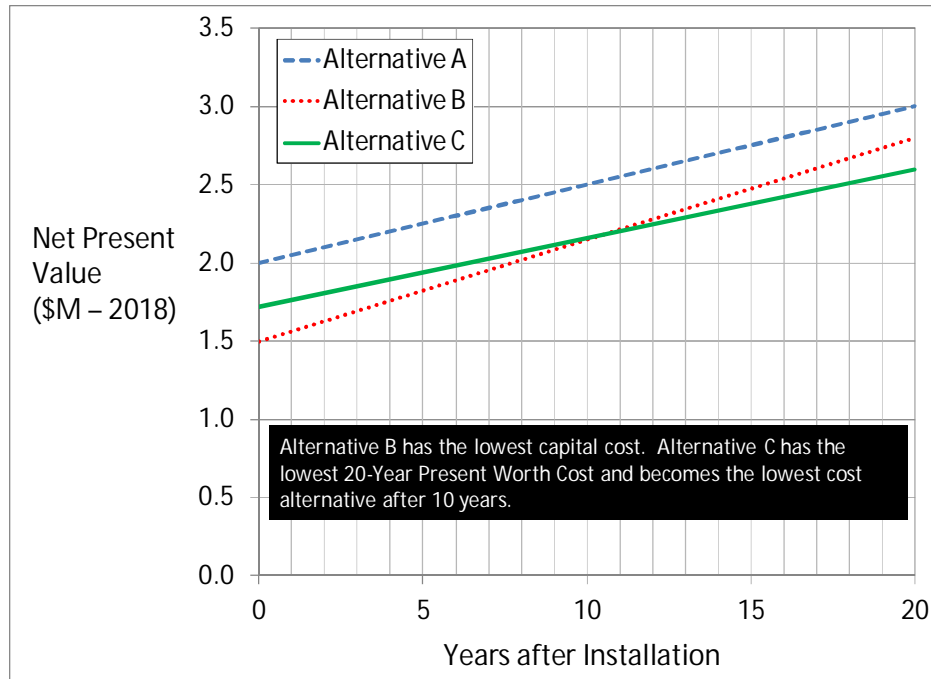


Figure 1 - Example Net Present Value Graphical Representation

User Rate Comparison

User rate implications will also be developed for competing alternatives. The public can better relate to user rate impacts compared to net present values. During times of decision-making and public acceptance, user rates will be used to give a simple perspective. The following method will be used to calculate the annual user rate increase associated with alternatives.

$$\text{Annual User Rate Increase} = X \times \frac{(A_{PI} + A_{OM})}{U}$$

where:

- X = % Revenue from Residential Class
- A_{PI} = Annual Principal and Interest Payment
- A_{OM} = Annual O&M Cost Increase
- U = Number of Residential Users

Non-Economic Factors

The Kickoff Workshop also identified non-economic factors that were grouped into five general categories. Non-economic factors help highlight characteristics of alternatives that are desirable but may not have an obvious financial impact. The following summarizes the five general categories that were agreed upon during the Workshop:

1. Operability, and Maintenance
2. Resiliency, Stability, Robustness
3. Quality of Life
4. Environment Stewardship and Sustainability
5. Longevity and Flexibility

These five categories provide broad areas where more specific criteria can further be defined as subsets to these categories. The following sections discuss the five categories and some potential subsets.

Operability, and Maintenance

Operability and Staffing

Upgrade alternatives can alter the staffing level requirements at the WWTP. Significant increases or changes in staffing levels requiring more “on-call” attention or 2nd or 3rd shift rotations would be less desirable. As a basis, an alternative that does not alter existing staffing levels or shift ratios would receive a higher score for this sub-category. Alternatives will receive lower scores if they impact the working conditions of the staff negatively by introducing increases in the requirements of staff or by increasing risk to the safety of staff.

Maintenance requirements

Upgrade alternatives can have differing levels of maintenance (both in complexity and frequency). When considering the number of systems and processes involved in the WWTP, it is important to consider the maintenance impacts for alternatives. Not all maintenance impacts are reflected in the cost evaluation.

Resiliency, Stability, Robustness

The WWTP’s main responsibility is to treat wastewater under an array of conditions. Resiliency, stability and robustness of an alternative relates to its ability to recover and perform under the dynamic conditions experienced throughout the years. This alternative characteristic also relates to an alternative’s ability to withstand unintended plant upsets or influxes in flows or loadings. A highly resilient, stable, and robust facility can continue to protect the environment during an unexpected natural disaster, safeguard capital investments, and continue serving the community without permit violations or system failures.

Quality of Life

The WWTP is located adjacent to a heavily used community park to the east, and recreational water bodies to the west and north. The facility’s close proximity to community assets heightens the importance of mitigating safety risks, pollution, noise, and odors at the facility. Alternatives will be evaluated based on continuing the facility’s success as it relates to maintaining and improving the community’s environment and health. In addition, plant traffic is a concern as it could increase congestion in the area. Since the plant is located nearby recreation areas, an increase in traffic could lead to negative perception towards that process or alternative. As a basis, a higher “quality of life” score would be given to an alternative that limits the disturbance to the public who are in close proximity to the WWTP.

Stewardship and Sustainability

Energy Balance

Minimizing energy use not only provides savings on cost, but it also minimizes the impact to the environment. Some alternatives may even produce new sources of energy that could be used at the facility and offset existing energy reliance. Public perception of the WWTP can be impacted by the facility's use of energy. Alternatives that positively contribute to reducing total net energy use will be more desirable.

Resource Recovery

A wastewater facility receives nutrients such as nitrogen and phosphorus every day it is operable. These nutrients can be recovered and recycled to other end uses. For example, biosolids disposal options are affected by the level of biosolids treatment therefore impacting the available end users. Alternatives that improve resource recovery and the ability to recycle nutrients for another sector will be ranked higher. An alternative that enhances resource recovery improves the environment and can boost public perception.

Another area of resource recovery is creating beneficial uses for the various products from the WWTP. These include water reuse, biogas utilization, heat recovery, and biosolids end-use.

Longevity and Flexibility

Changing regulation landscapes and improving technology can affect the longevity or usefulness of a process. Each alternative will be evaluated on its ability to be reconfigured to a different process in the future. For example, a Bio-P configuration that could be easily updated to adapt to new permit limits would receive a higher score than a configuration that would be costly to alter. This type of flexibility is desirable, as it could reduce future upgrade costs. Creatively repurposing the facility's already constructed infrastructure minimizes the reliance on new construction materials minimizing impacts on natural resources. Alternatives that can meet current and future effluent, air emissions, and biosolids regulations will be given higher scores which will be compounded by ability to adapt to current and future processes.

Non-economic Scoring Matrix

In order to quantify the importance non-economic and economic factors, a scoring matrix will be used to compare project alternatives. A weighting factor was assigned to each evaluation metric. Weighting factors capture the relative importance of each criteria with respect to the stake holders involved. The following summarizes the main evaluation metrics and their respective weighting factors:

Evaluation Metric Category	Weighting Factor*
Operability, and Maintenance	25%
Resiliency, Stability, Robustness	15%
Quality of Life	15%
Environment Stewardship, Sustainability	20%
Longevity and Flexibility	25%

*It may be appropriate on a case-by-case basis to adjust weights for a group of competing alternatives.

The weighting factors will help to produce a score under each category for each alternative. Scores will be combined, normalized, and weighted to create a composite score for each alternative. Figure 2 shows a sample scoring matrix to compare alternatives. It may be appropriate to adjust the weighting

factors for groups of competing alternatives The scoring matrix for each alternative evaluation will be revised and refined in the subsequent Facilities Plan phases.

Project Definition Evaluation Metrics	Operability, & Maintenance	Resiliency, Stability, Robustness	Quality of Life	Environmental Stewardship, Sustainability	Longevity and Flexibility	Totals
Weight	25%	15%	15%	20%	25%	100%
Scores (1 to 5)						
Alternative 1	5	4	3	2	3	-
Alternative 2	3	3	5	4	5	-
Weighted Scores						
Alternative 1	1.3	0.6	0.5	0.4	0.8	3.5
Alternative 2	0.8	0.5	0.8	0.8	1.3	4.0

Figure 2 - Sample Scoring Matrix for Alternatives

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **Floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 12N. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NINGS12
National Geodetic Survey
SSM/C-3, #6202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided by La Crosse County. The aerial photography was acquired in the spring of 2007 to create a 24-inch ground resolution and resampled to a 24-inch ground resolution.

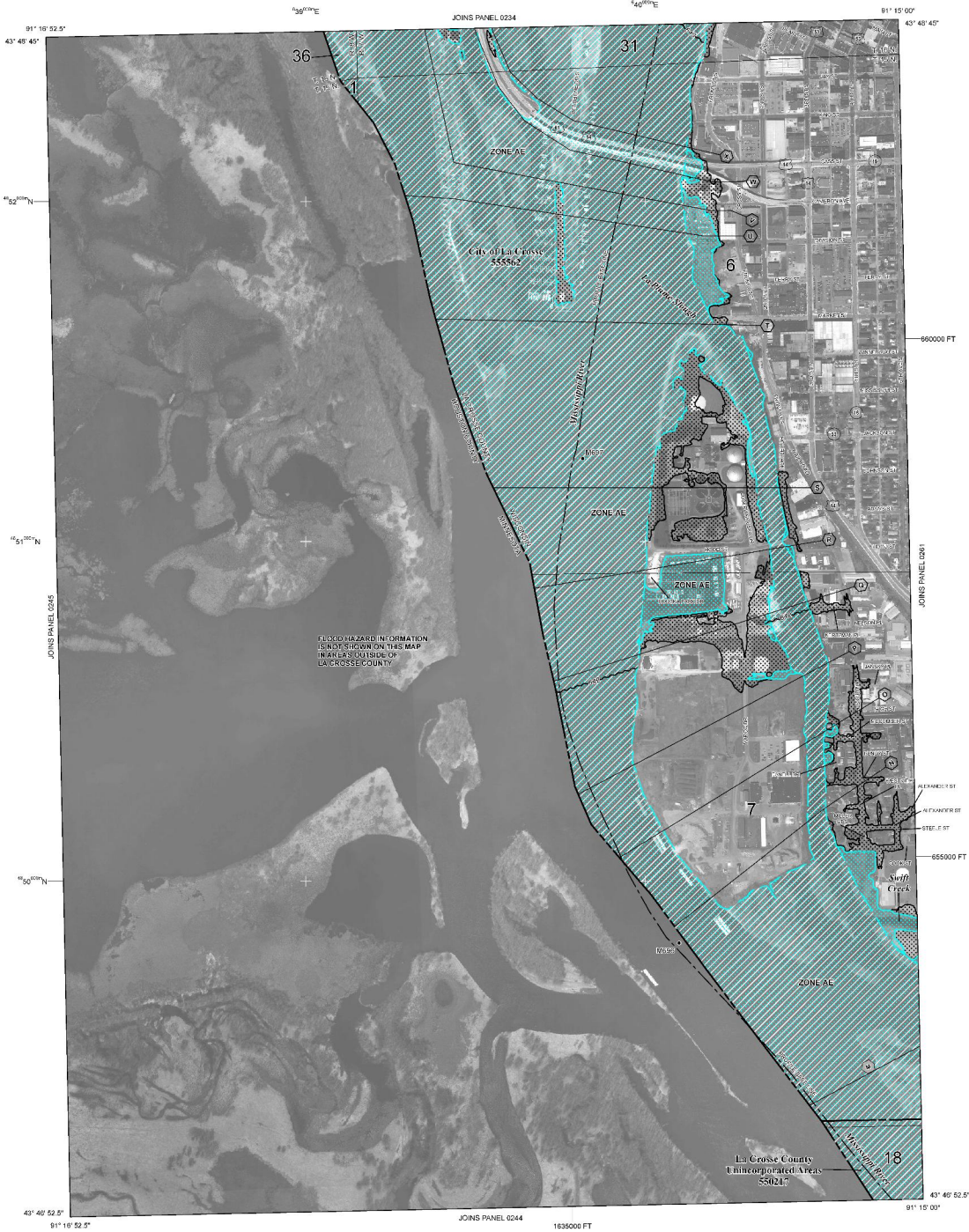
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baselines** in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels in which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://www.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information Exchange (MIEX)** at 1-877-FEMA-8347 (1-877-338-2627) or visit the FEMA website at <http://www.fema.gov/disaster/fip>.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the **base flood**, is the flood that has a 1% chance of being equaled or exceeded in any given year. The special flood hazard area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, AV, VE, and V. The Base Flood Elevation in the water surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (quality areas of ponding); Base Flood Elevations as determined.

ZONE AO Flood depths of 1 to 3 feet (quality areas of ponding); average depths determined; for areas of above fair flooding, velocities also determined.

ZONE AR Special flood hazard areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently determined. Zone AR indicates that the former flood control system is being removed to provide protection from the 1% annual chance or greater flood.

ZONE AV Area to be protected from the 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachments so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with changing areas less than 1 square mile; and areas protected by levees from the 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary
Floodway boundary
Zone boundary
Zone AE and Zone X boundary
Boundary dividing Special Flood Hazard Area Zones and boundary enclosing Special Flood Hazard Areas of different base Flood Elevations, flood depths, or flood velocities.
Base Flood Elevation line and value; elevation in feet
Base Flood Elevation value where uniform within zone; elevation in feet
Reference to the North American Vertical Datum of 1988

① Cross section line
A-A Transsect line
--- Culvert
--- Bridge
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) WGS84 Hemisphere
1100000 FT 5000-foot total; Wisconsin State Plane South Zone (SPS-Zone-NAD) Lambert Conformal Conic projection
1000-meter Universal Transverse Mercator grid values, zone 12N
X 106510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
M 61.5 River mile
MAN REPOSITORIES Refer to Map Repositories list on Map Index
EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP April 2, 2008
EFFECTIVE DATES OF REVISIONS TO THIS PANEL
April 2, 2008
For community map revision history prior to community mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6623.

MAP SCALE 1" = 600'
0 250 500 1000 FEET
0 100 200 METERS

NFIP PANEL 0242D

FIRM
FLOOD INSURANCE RATE MAP
LA CROSSE COUNTY,
WISCONSIN
AND INCORPORATED AREAS

PANEL 242 OF 425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSONVILLE, WI	00002	0242	E
LA CROSSE COUNTY	00007	0242	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 5063C0242D
MAP REVISED JANUARY 6, 2012
Federal Emergency Management Agency



Engineering Department

City of La Crosse
400 La Crosse Street
La Crosse, WI 54601-3396
(608)789-7505
Fax (608)789-7367

Parcel I.D. # 17-50256-010
905 Joseph Houska Drive
La Crosse, WI
54601

January 9, 2009

Dear City of La Crosse Property Owner,

This is in reference to a request that the City of La Crosse Engineering Department determine if the property described above is located within an identified Special Flood Hazard Area (SFHA), the area that would be inundated by a flood having a 1-percent chance of being equaled or exceeded in any given year (base flood), as shown on the effective Flood Insurance Rate Map. Using the revised Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) supplied to the City of La Crosse by the Federal Emergency Management Agency (FEMA) effective April 2nd, 2008, I have determined that the property referenced above is located in one following flood zones:

- ✓ SPECIAL FLOOD HAZARD AREA (SFHA) Subject to Inundation by the 1% Annual Chance Flood. (The 1% annual chance flood (100 Year), also known as the base flood which include Zones A, AE, AH, AO, A99, V, and VE)
- ✓ OTHER FLOOD AREAS Zone X (Areas of 0.2% annual chance flood (500 Year); areas of 1% annual chance flood with depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- ✓ OTHER AREAS (Areas determined to be outside the 0.2% annual chance floodplain)

The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood.

BFE for property described above: 642.3 feet (NGVD 1929)

Additional Information: From FEMA and the City of La Crosse

When making determinations on requests, the City of La Crosse bases its determination on the flood hazard information available at the time of the determination. Requesters should be aware that flood conditions may change or new information may be generated that would supersede the City of La Crosse's determination.

Requesters also should be aware that removal of a property (parcel of land or structure) from the Special Flood Hazard Area means the property is not subject to inundation by the flood having a 1-percent of being equaled or exceeded in any given year (base flood). This does not mean the property is not subject to other flood hazards. The property could be inundated by a flood with a magnitude greater than the base flood or by localized flooding not shown on the effective FIRM.

This letter is the determination made by the City of La Crosse Engineering Department. It *is not* a waiver of the condition that the property owners maintain flood insurance coverage for the property. *Only* the lender can waive the flood insurance purchase requirement because the lender imposed the requirement. *The property owner must request and receive a written waiver from the lender before canceling the policy.* The lender may determine, on its own as a business decision, that it wishes to continue the flood insurance requirement to protect its financial risk on the loan.

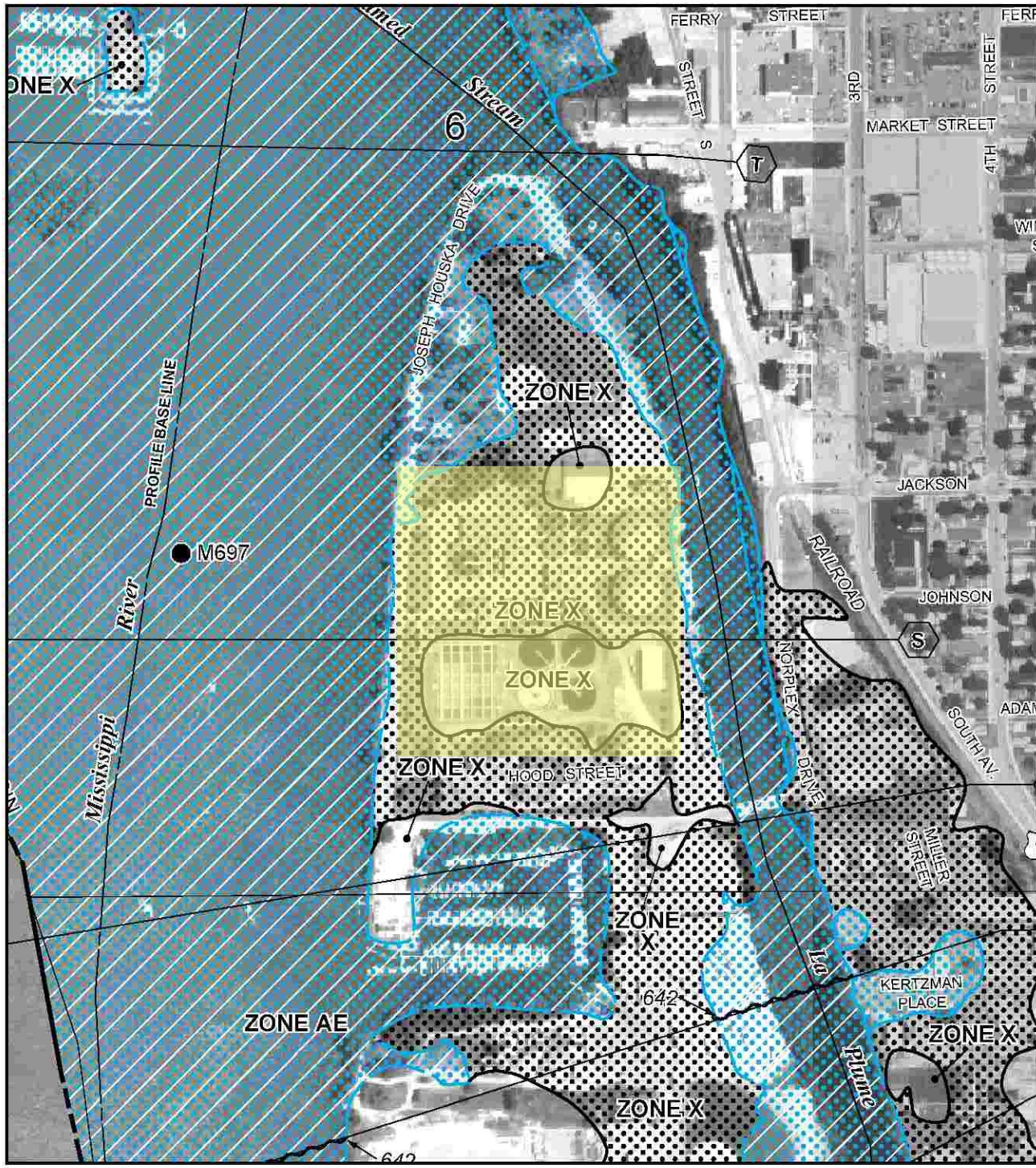
Even though structures are not located in the SFHA, as mentioned above, they could be flooded by a flooding event with a greater magnitude than the base flood. In fact, more than 25 percent of all claims paid by the NFIP are for policies for structures located outside the SFHA in Zones B, C, X (shaded), and X (unshaded). More than one fourth of all policies purchased under the NFIP protect structures located in these zones. The risk to structures located outside the SFHA is just not as great as the risk to structures located in SFHA's. Finally, approximately 90 percent of all federally declared disasters are caused by flooding, and homeowners insurance does not provide financial protection from this flooding. Therefore FEMA and the City of La Crosse encourage the widest possible coverage under the NFIP.

Issuance of this communication to you does not confer upon you any benefits or rights. If you are looking for a determination of your rights you must seek the advice of an attorney of your choosing. Please be advised that issuance of this communication does not create any duties or obligations for the City of La Crosse.

Douglas Kerns, CFM



City of La Crosse
Engineering Department



MAP SCALE 1" = 500'



NFIP

PANEL 0242C

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
LA CROSSE COUNTY,
WISCONSIN
AND INCORPORATED AREAS

PANEL 242 OF 420
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LA CROSSE COUNTY	550217	0242	C
LA CROSSE, CITY OF	555662	0242	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
55063C0242C
EFFECTIVE DATE
APRIL 2, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Existing Unit Processes
 Isle La Plume WWTP
 City of La Crosse, WI

Design Flow and Load

Design Flow and Load			
Average Design Flow (Dry Weather)	20	mgd	
Average Design Flow (Wet Weather)	44	mgd	
Design Influent BOD Loading	29,793	lb/d	

Raw Wastewater Screening

Screen Type	Step Screen			
Number of Screens	1			
Opening Size	0.25	inch		
Capacity	20.00	mgd	=	13,889 gpm
Screenings washer/compactor	1			
Capacity	70	cu ft/hr		
Comminutors	2			
Size	1.5	HP		
Year				
Infrastructure	2002			
Screen	2002			
Washer/compactor	2002			
Comminutors	1970			

Notes: Headworks building new in 2002. Screen installed in refurbished Comminutor Pit

Raw Wastewater Pumping

Pump Type	Vertical, non-clog, dry-pit centrifugal			
Number of Pumps	4			
Capacity per Pump	8,400	gpm		
Year				
Infrastructure	1970			
Pumps	1970			

Notes:

Pump Type	Vertical, non-clog, dry-pit centrifugal			
Number of Pumps	1			
Capacity per Pump	6,950	gpm		
Year				
Infrastructure	1936			
Pumps	1952			

Notes: Across the line starting

Total Raw Wastewater Pumping Capacity	40,550	gpm	=	58.4	mgd
Firm Raw Wastewater Pumping Capacity	32,150	gpm	=	46.3	mgd

Grit Removal

Number of Basins	2			
Type	Vortex			
Dimensions				
Diameter	16.0	ft		
Depth	14.3	ft		

	Volume per Basin	2,792 gal
	Total Volume	5,584 gal
	Design Capacity	20.0 mgd
Year		
	Infrastructure	2002
	Equipment	2002

Notes: Pista type units, each tanks is made up of 2 different size circular tanks, 16X5.3 ft and 6.8X5 ft

Grit Pumping and Washers

Pump Type	Horizontal, Dry-Pit Recessed Impeller	
Total Number of Pumps	2	
Capacity per Pump	250 gpm	
Year		
	Infrastructure	2002
	Pump	2002
Grit Washers	Coanda Tulip	
Number	2	
Capacity per washer	250 gpm	
Total capacity	500 gpm	
Year		
	Infrastructure	2002
	Equipment	2002

Primary Clarifiers

Total Number of Clarifiers	5	
Clarifier #1		
	Length	112.1 ft
	Width	25.5 ft
	Sidewater Depth	10.0 ft
	Surface Area	2,859 sq ft
	Volume	28,586 cu ft
	Rehab	2004
Clarifier #2		
	Length	112.1 ft
	Width	27.0 ft
	Sidewater Depth	10.0 ft
	Surface Area	3,027 sq ft
	Volume	30,267 cu ft
	Rehab	2004
Clarifier #3		
	Diameter	90.0 ft
	Sidewater Depth	10.0 ft
	Surface Area	6,362 sq ft
	Volume	63,617 cu ft
	Rehab	2003
Clarifier #4		
	Diameter	90.0 ft
	Sidewater Depth	12.0 ft
	Surface Area	6,362 sq ft
	Volume	76,341 cu ft
	Rehab	2003
Clarifier #5		
	Diameter	90.0 ft
	Sidewater Depth	12.0 ft
	Surface Area	6,362 sq ft
	Volume	76,341 cu ft

Rehab 2003

Total Surface Area	24,970	sq ft
Total Volume	275,151	cu ft
SOR at Design Dry Weather Flow	801	gpd/sq ft
SOR at Design Wet Weather Flow	1,762	gpd/sq ft

Primary Sludge and Scum Pumping

Sludge Pump Type	Centrifugal
Total Number of Pumps	3
Firm Number of Pumps	2
Capacity per Pump	550 gpm
Firm Capacity	1,100 gpm
Year	

Equipment Plant 1 primary sludge pump (1) 2001 and Plant 2 pumps (2) 2008

Plant 2 Primary Scum Pumping

Scum Pump Type	Rotary Lobe
Total Number of Pumps	2
Firm Number of Pumps	1
Capacity per Pump	100 gpm
Firm Capacity	100 gpm
Year	

Equipment 2008

Settled Sewage Effluent Pumps

Pump Type	Vertical, non-clog, dry-pit centrifugal
Total Number of Pumps	4
Firm Number of Pumps	3
Capacity	8,400 gpm
Firm Capacity	25,200 gpm
Year	

Infrastructure 1970
Equipment 1970

Notes: 3 of the pumps have VFDs (When was P4 refurbished)

Activated Sludge (BNR) Tanks

Tank No.	L (ft)	W (ft)	D (ft)	Volume (cu ft)	Volume (gal)
1A	99.5	35	16	55,720	416,813 gal
1B	99.5	35	16	55,720	416,813 gal
2C	99.5	35	16	55,720	416,813 gal
2D	99.5	35	16	55,720	416,813 gal
3D	200	35	16	112,000	837,816 gal
4D	200	35	16	112,000	837,816 gal
5C	99.5	35	16	55,720	416,813 gal
5D	99.5	35	16	55,720	416,813 gal
6A	99.5	35	16	55,720	416,813 gal
6B	99.5	35	16	55,720	416,813 gal

A, B Zones are Anaerobic	Total Anaerobic	1,667,254 gal
C Zones are Anoxic	Total Anoxic	833,627 gal
D Zones are Aerobic	Total Aerobic	2,509,259 gal

Criteria - Volumetric Loading	40 lb BOD/kcf/d (1)
Primary Effluent BOD Loading Capacity	26,790 lb/d
Average Removal in Primary Clarifier	30 %

Influent BOD Loading Capacity	38,272	lb/d	
Criteria - F:M	0.2 - 0.5	d ⁻¹	
Average MLSS	2500	mg/L	(2)
BOD Capacity @ 0.5 F:M	52,231		
Aeration Type	Membrane Fine Bubble Diffusers		

Year		
Infrastructure	1970	
Equipment	2012	

Anerobic/Anoxic Zone Mixers		
Type	Submersible Propeller	
Number	6	
Capacity per mixer	7,000	gpm
Year		
Equipment	1998	

Anerobic/Anoxic Zone Mixers		
Type	Submersible Propeller	
Number	2	
Capacity per mixer	7,000	gpm
Year		
Equipment	1998	

Aeration Blowers		
Blower Type	High Speed Turbo	
Number of Blowers	4	
Capacity per Blower	5100	scfm
Year	2012	
Total Aeration Capacity	20,400	
Firm Aeration Capacity	15,300	

Final Clarifiers		
Type	Circular	
Total Number of Clarifiers	4	
Dimensions		
Diameter	120	ft
Sidewater Depth	12	ft
Surface Area per Basin	11309.73	sq ft
Volume	135716.8	cu ft
Total Surface Area	45238.93	sq ft
Total Volume	542867.2	cu ft
Average MLSS	2500	mg/L
Average RAS Rate	0.79	
Solids Loading at Design Dry Weather Flow	16.49973	lb/d/sq ft
Solids Loading at Design Wet Weather Flow	36.2994	lb/d/sq ft
Maximum MLSS Capacity at Design Dry Weather Flow	5090.994	mg/L
Year		
Infrastructure	1970	
Equipment	1970	

Notes: Complete Rehabilitation in 2004 and 2005

RAS Pumping	
Pump Type	Vertical Turbine (Mix Flow)
Total Number of Pumps	3
Firm Number of Pumps	2

Capacity per Pump	3,500	gpm
Firm Capacity		gpm
Year		
Infrastructure	1970	
Equipment	1970	

Notes: One pump runs constant and a second varies on VFD, 3rd is backup

WAS Pumping

Pump Type	Vertical Turbine (Mixed Flow)	
Total Number of Pumps	2	
Firm Number of Pumps	1	
Capacity per Pump	2,400	gpm
Firm Capacity	2,400	gpm
Year		
Infrastructure	1970	
Equipment	1970	

Notes: One pump operates on operator input time schedule and speed(VFD) other pump is backup

Disinfection

Type	Ultraviolet	
Number of Channels	3	
Capacity	14.0	mgd each
Capacity at Peak Flows	42.0	mgd
Year		
Infrastructure	1990	
Equipment	2005	#1,#2
	2008	#3

Gravity Thickeners

Type	Circular			
Number	2			
Dimensions				
Diameter	50.0	ft		
Sidewater Depth	10.0	ft		
Surface Area	1,963	sq ft		
Volume	19,635	cu ft =	146,869	gal
Cone Volume	3,272	cu ft =	24,475	gal
Tank Volume	22,907	cu ft =	171,344	gal
Total Surface Area (2 tanks)	3,927	sq ft		
Total Volume (2 tanks)	45,814	cu ft =	342,688	gal
Year				
Infrastructure	1970			
Equipment	1970			

Ferric Chloride Storage and Feed System

Storage Type	Fiberglass Storage Tank			
Number	1			
Capacity	10,000	gallons		
Year, Equipment	1998			
FeCl Feed Pump Type	Chemical Metering			
Number	3			
Capacity	1.3	gpm		
Total Capacity	3.9	gpm		
Year, Equipment	1998			

Thickened Sludge Transfer Pumping (to digesters)

Pump Type	Rotary Lobe
Total Number of Pumps	2
Firm Number of Pumps	2
Capacity per Pump	160 gpm
Firm Capacity	gpm
Year	
Infrastructure	1970
Equipment	2008

Anaerobic Solids Digestion

No. of Digesters	4
Digester No. 1	
Diameter	74.5 ft
Sidewater Depth	20 ft
Cone Volume	108580 gal
Volume	760753.4 gal
Digester No. 2	
Diameter	65 ft
Sidewater Depth	20 ft
Cone Volume	55130 gal
Volume	551581.9 gal
Digester No. 3	
Diameter	65 ft
Sidewater Depth	18 ft
Cone Volume	55130 gal
Volume	501936.8 gal
Digester No. 4	
Diameter	74.5 ft
Sidewater Depth	20 ft
Cone Volume	108580 gal
Volume	760753.4 gal
Total Digester Volume	2575025 gal
	344231.7 cu ft
Raw Sludge Loading Limit	171668.4 gpd
VS Loading Rate	27538.54 lb/d
Year	
Infrastructure	1936 #2,#3
	1952 #1,#4
Equipment	2015-2018 #2,#3, #1, #4

Digester Gas Equipment

Waste Gas Burner	
Control	Electric actuated valve with PRV bypass
Capacity	Unknown cf/hr
Year	
Equipment	1997

Notes: History shows to it handles up to 6000 cf/hr

Boiler/Heat Exchangers

Type	Tube in Tube
Number	1
Fuel Source	Biogas/Natural Gas

Boiler Capacity	2,125,000	BTU/hr
Heat Exchanger Capacity	2,000,000	BTU/hr
Digester Temperature	95-98	deg F
Type	Hotwater Bath	
Number	1	
Fuel Source	Biogas/Natural Gas	
Boiler Capacity	2,000,000	BTU/hr
Heat Exchanger Capacity	2,000,000	BTU/hr
Digester Temperature	95-98	deg F
Year	1988	Sludge Heater No. 1
Equipment	1980	Sludge Heater No. 2

Digester Recirculation Pumping		
Pump Type	Centrifugal	
Total Number of Pumps	2	
Firm Number of Pumps	1	
Capacity per Pump	500	gpm
Firm Capacity	500	gpm
Year	1952	
Infrastructure	1952	
Equipment	1952	

Feed Pump to Gravity Belt Thickener		
Pump Type	Progressive Cavity	
Number of Pumps	1	
Capacity per Pump	500	gpm
Year	1998	
Infrastructure	1998	
Equipment	1998	

Notes: Operates on VFD

Gravity Belt Thickening		
Type	Gravity Belt Thickener	
Number	1	
Size	2 meter	
Capacity	700	gpm
Max Solids Loading Rate	3700	lb/h
Year	1998	
Infrastructure	1998	
Equipment	1998	

Biosolids Transfer Pumping (GBT to Storage)		
Pump Type	Progressive Cavity	
Number of Pumps	1	
Capacity per Pump	135	gpm
Year	1998	
Infrastructure	1998	
Equipment	1998	

Notes: Speed varies (VFD) based on level in discharge hopper

Liquid Biosolids Storage		
Type	Glass-Lined Steel Tanks	
Number	2	
Dimensions		

Diameter	151.0 ft	
Depth	23.8 ft	
Volume	426,207 c	3.2 MG
Total Volume	6,376,485 g	6.4 MG
Year		
Tanks	1999	

Biosolids Mixing Pumps

Pump Type	Centrifugal Chopper
Total Number of Pumps	2
Firm Number of Pumps	1
Capacity per Pump	5,250 gpm
Firm Capacity	5,250 gpm
Year	
Equipment	1999

Biosolids Tanker Loading Pumps

Pump Type	Centrifugal Chopper
Total Number of Pumps	2
Firm Number of Pumps	1
Capacity per Pump	1,300 gpm
Firm Capacity	1,300 gpm
Year	
Equipment	1999

Belt Filter Press Feed Pumps

Pump Type	Progressing Cavity
Total Number of Pumps	1
Capacity	300 gpm
Year	
Equipment	1999

Liquid Polymer Storage and Feed System

Storage Type	Plastic Tank
Number	4
Capacity per Tank	1,000 gallons
Total Storage Capacity	4,000 gallons
Year, Equipment	1999

BFP Liquid Polymer Feed Pumps

	Dyna-Blend
Number	3
Capacity	0.1 gpm
Total Capacity	0.3 gpm
Year, Equipment	1999

GBT Liquid Polymer Feed Pump1

	Dyna-Blend
Number	1
Capacity	0.1 gpm
Year, Equipment	1999

Belt Filter Press

Number	1
Size	2 meter
Capacity	126 gpm
Solids Loading Capacity	2500 lb/h
Year	
Infrastructure	1999

Equipment

1999

Notes: 126 gpm is at 2.7% solids

Cake Biosolids Storage

Type

Concrete push walls with steel building cover.

Number

1

Dimensions

Length

125.0 ft

Width

60.0 ft

Push Wall Height

6 ft

Storage Volume

18,750 cu ft

2.5 ft depth

45,000 cu ft

Full Depth

1,667 cu yd

Full Depth

Year

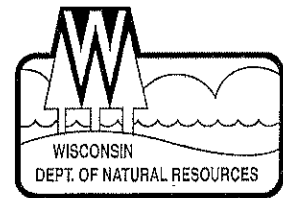
Structure

1999

Notes:

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
West Central Region Headquarters
1300 W. Clairemont Ave.
Eau Claire, WI 54701

Scott Walker, Governor
Cathy Stepp, Secretary
Dan Baumann, Regional Director
Telephone (715) 839-3700
FAX (715) 839-6076
TDD (715) 839-2786



RECEIVED
DEC 10 2015

Timothy Kabat
Mayor
La Crosse, City of
400 La Crosse Street, Mayor's Office
La Crosse, WI 54601

SUBJECT: WPDES Permit Reissuance No. WI-0029581-09-0
La Crosse, City of, 905 Joseph Houska Drive

Dear Permittee:

Your Wisconsin Pollutant Discharge Elimination System (WPDES) Permit is enclosed. The conditions of the enclosed permit reissuance were determined using the permit application, information from your WPDES permit file, other information available to the Department, comments received during the public notice period, and applicable Wisconsin Administrative Codes. All discharges from this facility and actions or reports relating thereto shall be in accordance with the terms and conditions of the enclosed permit.

This enclosed permit requires you to submit monitoring results to the Department on a periodic basis. Monitoring forms, which must be submitted electronically, are available on the Department's web page. Go to the DNR Switchboard page at <http://dnr.wi.gov/topic/switchboard/> to log in and access your monitoring forms. For your convenience, there is a 'Summary of Reports Due' at the end of the enclosed permit that shows a synopsis of the required reports and monitoring forms.

The WPDES permit program has been approved by the Administrator of the U.S. Environmental Protection Agency pursuant to Section 402(b) of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. Section 1342 (b)). The terms and conditions of the enclosed permit are accordingly subject to enforcement under ss. 283.89 and 283.91, Stats., and Section 309 of the Federal Act (33 U.S.C. Section 1319).

The Department has the authority under chs. 160 and 283, Wis. Stats., to establish effluent limitations, monitoring requirements, and other permit conditions for discharges to groundwater and surface waters of the State. The Department also has the authority to issue, reissue, modify, terminate, or revoke and reissue WPDES permits under ch. 283, Wis. Stats.

The enclosed permit contains water quality-based effluent limitations that are necessary to ensure the water quality standards for the Mississippi River in the Lower La Crosse River Watershed of the Bad Axe – La Crosse Rivers Basin located in La Crosse County are met. You may apply for a variance from the water quality standard used to derive the limitations pursuant to s. 283.15, Stats., by submitting an application to the Director of the Bureau of Water Quality, P.O. Box 7921, Madison, Wisconsin 53707 within 60 days of the date the permit was issued (see "Date Permit Signed/Issued" after the signature on the front page of the enclosed permit). This statute also allows the permittee to apply for a variance to the water quality standard when applying for reissuance of the permit. Subchapter III of ch. NR 200, Wis. Adm. Code, specifies the procedures that must be followed and the information that must be included when submitting an application for a variance.

If your permit contains a stringent Water Quality Based Effluent Limit for Phosphorus, there is a Compliance Schedule requirement to complete a Phosphorus Operational Evaluation and Optimization Report. To streamline the Report preparation and review process the Department has prepared a Worksheet which should be used to develop the report. The worksheet can be found at : <http://dnr.wi.gov/topic/surfacewater/phosphorus.html>. To challenge the reasonableness of or necessity for any term or condition of the enclosed permit, s. 283.63, Stats., and ch. NR 203, Wis. Adm. Code, require that you file a verified petition for review with the Secretary of the Department of Natural Resources within 60 days of the date the permit was issued (see "Date Permit Signed/Issued" after the signature on the front page of the enclosed permit). For permit-related decisions that are

not reviewable pursuant to s. 283.63, Stats., it may be possible for permittees or other persons to obtain an administrative review pursuant to s. 227.42, Stats., and s. NR 2.05(5), Wis. Adm. Code, or a judicial review pursuant to s. 227.52, Stats. If you choose to pursue one of these options, you should know that Wisconsin Statutes and Administrative Code establish time periods within which requests to review Department decisions must be filed.

Sincerely,



Michael Vollrath
Wastewater Field Supervisor

Dated: December 7, 2015

cc: Julia Stephenson , Legal Permit File - LAX
Cyndi Barr, WT/3
Jared Greeno, Plant Operator, 905 Joseph Houska Dr, La Crosse, WI 54601
U.S. Fish and Wildlife Service (Electronic Copy via Email)
EPA – Region V (Electronic Copy via Email)

STATE OF WISCONSIN DEPARTMENT OF NATURAL RESOURCES

NOTICE OF FINAL DETERMINATION TO REISSUE

A WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM (WPDES) PERMIT No. WI-0029581-09-0

Permittee: La Crosse, City of, 905 Joseph Houska Dr, La Crosse, WI, 54601

Facility Where Discharge Occurs: La Crosse, City of, 905 Joseph Houska Drive

Receiving Water And Location: the Mississippi River in the Lower La Crosse River Watershed of the

Bad Axe – La Crosse Rivers Basin located in La Crosse County

Brief Facility Description: The City of La Crosse owns and operates an activated sludge type wastewater treatment facility on Isle La Plume with discharge to the Mississippi River. The annual average design flow of the facility is 20 million gallons per day (MGD), and the actual annual average flow in 2014 was 11.67 MGD. Treatment processes include, an influent fine screen, grit removal, primary clarification, aeration tanks with biological phosphorus removal, effluent clarification with UV disinfection. Sludge is processed using anaerobic digestion and mechanical sludge dewatering. Changes in operation since the last permit term includes a new high efficiency turbine blowers to aerate the BNR system. Future planned changes include optimizing the sludge anaerobic digesters to produce higher quality sludge, and addressing effluent phosphorus reduction. Proposed monitoring changes include an alternative mercury effluent limit with continuation of their mercury pollutant minimization program, new effluent total nitrogen series monitoring, new effluent copper limits with a compliance schedule to meet them, effluent hardness monitoring, and lower effluent phosphorus limits with a compliance schedule to meet them.

Permit Drafter's Name, Address and Phone: Angela Parkhurst, DNR, WCR Headquarters, 1300 W. Clairemont Ave. Eau Claire, WI, 54701, (715) 839-3836

Basin Engineer's Name, Address, and Phone: Julia Stephenson, 3550 Mormon Coulee Road, La Crosse, WI 54601, (608) 785-9981

Date Permit Signed/Issued: December 7, 2015

Date of Effectiveness: January 1, 2016

Date of Expiration: December 31, 2020

Following the public notice period the Department has made a final determination to reissue the WPDES permit for the above-named permittee for this existing discharge. The permit application information from the WPDES permit file, comments received on the proposed permit and applicable Wis. Adm. Codes were used as a basis for this final determination.

The Department has the authority to issue, modify, suspend, or revoke WPDES permits and to establish effluent limitations and permit conditions under ch. 283, Stats.

Following is a summary of significant comments and any significant changes which have been made in the terms and conditions set forth in the draft permit:

Comments Received from the Applicant, Individuals or Groups and Any Permit Changes as Applicable

The City of La Crosse submitted the following comments via email April 17, 2015. The DNR responses follow each comment.

1. The City requests that the effluent copper limits, along with the monitoring requirement for hardness, be eliminated from the proposed permit due to inaccurate data.

DNR Response: The data was shown to be inaccurate, and the newer correct data demonstrates the copper limits and corresponding hardness monitoring is not needed. The copper limits and hardness monitoring were removed from the permit.

2. The City requests that the language for the Operational Evaluation Report in the phosphorus compliance schedule be eliminated from the proposed permit along with the due date for implementation as the City is concerned that this language is vague with respect to how the City is to demonstrate compliance with the requirement.

DNR Response: An interim limit for phosphorus has been given as well as the compliance schedule. The expectation is that the interim limit will continue to be met and that is how the City will demonstrate compliance with the requirement. Therefore, no changes were made to the compliance schedule language.

3. Due to a Wisconsin Circuit Court decision July 11, 2014 regarding ammonia limits, the City requests the effluent ammonia limits be removed and monitoring reduced because of the lack of reasonable potential to exceed the limits by the facility.

DNR Response: A court decision on July 11, 2014 rendered s. NR 106.33(2) invalid. As a result of this decision, the seasonal 20 and 40 mg/L thresholds for including ammonia limits in municipal discharge permits are no longer applicable under current rules. As such, s. NR 106.33(1) enables the Department to determine the need to include new ammonia limits in municipal discharge permits based on the statistical comparisons in s. NR 106.05. The reasonable potential analysis was documented during a previous permit issuance process, and a daily maximum ammonia limit has been in effect since November 2004 for this facility. Daily maximum limitations are based on acute toxicity criteria, which are a function of the effluent pH and the receiving water classification. A review of daily pH values from the most recent three years shows that the upper 99th percentile is 8.0 s.u., with results as high as 8.4 s.u. reported. This corresponds to a daily maximum Ammonia Nitrogen limit of 20 mg/L. This value was exceeded on 10 occasions during the current permit term, the 1-day P99 of the effluent being 27 mg/L with a maximum reported value of 28.6 mg/L. To account for the range of effluent pH and ammonia results encountered at La Crosse the table in section 3.2.1.2 in the draft permit was substituted with the following table:

Effluent pH (s.u.)	NH ₃ -N Limit (mg/L)
pH ≤ 7.6	No Limit
7.6 < pH ≤ 7.7	29
7.7 < pH ≤ 7.8	24
7.8 < pH ≤ 7.9	20
7.9 < pH ≤ 8.0	17
8.0 < pH ≤ 8.1	14
8.1 < pH ≤ 8.2	11
8.2 < pH ≤ 8.3	9.4
pH ≥ 8.4	7.8

Comments Received from EPA or Other Government Agencies and Any Permit Changes as Applicable

The EPA submitted preliminary permit review comments as part of the FY 2015 permits for review are listed below, followed by the DNR responses.

1. The type of collection system should be listed in the fact sheet as well as the percent combined versus separation of the system.

DNR Response: The service area is 100% separate sewer collection system. This was noted in the fact sheet.

2. The receiving water body impairments should be listed in the fact sheet.

DNR Response: The following information was added to the Fact Sheet in the General Information Section: The facility discharges to the Mississippi River sections of Pool 8 where it is listed as impaired for contaminated fish tissue from PCBs and Mercury, as well as water quality use restrictions from phosphorus. This was noted in the fact sheet.

3. The identification of the biosolids land application sites or where the list can be viewed should be listed in the fact sheet.

DNR Response: The following information was added to the Fact Sheet in the Sludge Requirements Section: "Land application of waste shall be done in accordance with permit conditions and applicable codes. All land application sites shall be approved prior to their use. To receive a list of approved sites, or to be notified of potential approvals, please contact the regional wastewater specialist."

4. It is recommended that the stormwater coverage be mentioned in the fact sheet.

DNR Response: The following information was added to the Fact Sheet: in the General Information section: The City of La Crosse is covered under the Municipal Separate Storm Sewer System (MS4) General Permit (No. WI-S050075-2) which took effect on May 1, 2014. The City was originally covered under the MS4 General Permit issued January 19, 2006. Information regarding the programs and activities required under the MS4 permits can be found at: <http://dnr.wi.gov/topic/stormwater/municipal>.

5. A sketch or detailed description of the location of the discharge should be included in the permit or the fact sheet.

DNR Response: The following information was added to the Fact Sheet for Outfall 001: Outfall location is at 43N 48°0" and 91W 15°34", 50 ft off the east bank of the main channel of the Mississippi River, approximately 0.625 miles downstream of the existing US Highway 14, 16, and 61 main channel bridge.

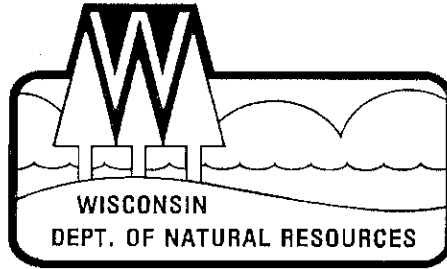
6. On February 1, 2014, Wisconsin Administrative Code Streamlining rules went into effect for POTWs pretreatment programs. The permit contains general language for pretreatment program modifications due to state of federal law changes but it is the expectation that more detailed language be included in

the draft permit to ensure that the WWTP incorporates streamlining rule updates into its Sewer Use Ordinance. Please include detailed language specific to the streamlining rule changes into the draft permit requirements for the pretreatment program.

DNR Response: The City of La Crosse has already submitted their pretreatment modification incorporating the Streamlining requirements so revising their WPDES permit to require that submittal is not needed.

As provided by s. 283.63, Stats., and ch. 203, Wis. Adm. Code, persons desiring further adjudicative review of this final determination may request a public adjudicatory hearing. A request shall be made by filing a verified petition for review with the Secretary of the Department of Natural Resources within 60 days of the date the permit was signed (see permit signature date above). Further information regarding the conduct and nature of public adjudicatory hearings may be found by reviewing ch. NR 203, Wis. Adm. Code, s. 283.63 Stats., and other applicable law, including s. 227.42, Stats.

Information on file for this permit action may be inspected and copied at either the above named permit drafter's address or the above named basin engineer's address, Monday through Friday (except holidays), between 9:00 a.m. and 3:30 p.m. Information on this permit action may also be obtained by calling the permit drafter at (715) 839-3836 or by writing to the Department. Reasonable costs (usually 20 cents per page) will be charged for copies of information in the file other than the public notice and fact sheet. Pursuant to the Americans with Disabilities Act, reasonable accommodation, including the provision of informational material in an alternative format, will be made to qualified individuals upon request.



WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
**PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE
ELIMINATION SYSTEM**

City of La Crosse

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility
located at
905 Joseph Houska Drive
to
**the Mississippi River in the Lower La Crosse River Watershed
of the Bad Axe – La Crosse Rivers Basin located in La Crosse County**

in accordance with the effluent limitations, monitoring requirements and other conditions set
forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By

Michael Vollrath
Wastewater Field Supervisor

December 7, 2015

Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE - January 01, 2016

EXPIRATION DATE - December 31, 2020

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1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)
701	Representative influent samples shall be collected prior to the grit removal and filtrate/centrate return.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - INFLUENT PRIOR TO GRIT REMOVAL

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Continuous	Continuous	
BOD ₅ , Total		mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	Daily	24-Hr Flow Prop Comp	
Cadmium, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Chromium, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Copper, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Lead, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Nickel, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Zinc, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Cyanide, Total		µg/L	Monthly	Grab	
Mercury, Total Recoverable		ng/L	Monthly	24-Hr Flow Prop Comp	

1.2.1.1 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

1.2.1.2 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified, unless not possible using the most sensitive approved method.

1.2.1.3 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2 In-Plant Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	Sampling Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)
106	A representative in plant sample shall be collected for a Mercury field blank using standard sample handling procedures.

2.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point 106 - MERCURY FIELD BLANK

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Mercury, Total Recoverable		ng/L	Monthly	Blank	

2.2.1.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3 Surface Water Requirements

3.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)
001	Representative effluent samples shall be collected following secondary clarification and prior to discharge to the Mississippi River.

3.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 001 - PRIOR TO DISCHARGE

Monitoring Requirements and Effluent Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Continuous	Continuous	
CBOD ₅	Monthly Avg	25 mg/L	Daily	24-Hr Flow Prop Comp	
CBOD ₅	Weekly Avg	40 mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total	Monthly Avg	30 mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total	Weekly Avg	45 mg/L	Daily	24-Hr Flow Prop Comp	
pH Field	Daily Max	9.0 su	Daily	Grab	
pH Field	Daily Min	6.0 su	Daily	Grab	
Cadmium, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Chromium, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Lead, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Nickel, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Zinc, Total Recoverable		µg/L	Monthly	72-Hr Flow Prop Comp	
Cyanide, Total		µg/L	Monthly	Grab	
Nitrogen, Ammonia (NH ₃ -N) Total	Daily Max - Variable	mg/L	Weekly	24-Hr Flow Prop Comp	See ammonia subsection below.
Nitrogen, Ammonia Variable Limit		mg/L	Weekly	24-Hr Flow Prop Comp	See ammonia subsection below.

Monitoring Requirements and Effluent Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Fecal Coliform	Geometric Mean	400 #/100 ml	2/Week	Grab	Limit and monitoring effective May-Sept annually.
Acute WET		TU _a	See Listed Qtr(s)	24-Hr Flow Prop Comp	Tests required annually, rotating quarters. See Acute subsection below.
Nitrogen, Total		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	
Phosphorus, Total	Monthly Avg	1.0 mg/L	5/Week	24-Hr Flow Prop Comp	Interim limit of 1.0 mg/L monthly average effective throughout the permit term. Final limits of 0.100 mg/L, 17 lbs 6-month avgs and 0.300 mg/L monthly avg effective next permit term. See phosphorus footnote below and compliance schedule.
Copper, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	
Mercury, Total Recoverable	Daily Max	4.8 ng/L	Monthly	Grab	See Mercury subsection below and compliance schedule.

3.2.1.1 Average Annual Design Flow

The average annual design flow of the permittee's wastewater treatment facility is 20 MGD.

3.2.1.2 Ammonia Nitrogen Effluent Limitations

Acute Ammonia limitations (daily maximums) are based on the effluent pH. Below is a table which states the applicable ammonia limit for various pH values from 6.0 to 9.0 standard units (s.u.) and should be used to determine the daily maximum ammonia limit to be reported on the DMRs. When measuring pH, rounding to the nearest 0.1 is required. For example, if the pH reading is 7.14 it should be rounded to 7.1. If the pH reading was 7.15, it should be rounded to 7.2. These limits apply year-round unless noted below.

Effluent pH (s.u.)	NH ₃ -N Limit (mg/L)
pH ≤ 7.6	No Limit
7.6 < pH ≤ 7.7	29*
7.7 < pH ≤ 7.8	24*
7.8 < pH ≤ 7.9	20*
7.9 < pH ≤ 8.0	17

8.0 < pH ≤ 8.1	14
8.1 < pH ≤ 8.2	11
8.2 < pH ≤ 8.3	9.4
pH ≥ 8.4	7.8

* During the months of May through October if the pH is less than or equal to 7.6 there is no daily maximum limit for NH3-N. Limits shown in the table above with an asterisk * would only apply from November through April.

3.2.1.3 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

3.2.1.4 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified at a level of quantitation below the calculated/potential effluent limit, unless not possible using the most sensitive approved method.

3.2.1.5 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.1.6 Phosphorus Water Quality Based Effluent Limitation(s)

The final water quality based effluent limits for phosphorus are 0.100 mg/L, 17 lbs/day 6-month average and 0.300 mg/L monthly average will take effect per the Compliance Schedule unless:

- (A) As part of the application for the next reissuance, or prior to filing the application, the permittee submits either: 1.) a watershed adaptive management plan and a completed Watershed Adaptive Management Request Form 3200-139; or 2.) an application for water quality trading; or 3.) an application for a variance; or 4.) new information or additional data that supports a recalculation of the numeric limitation; and
- (B) The Department modifies, revokes and reissues, or reissues the permit to incorporate a revised limitation before the expiration of the compliance schedule*.

Note: The permittee may also submit an application for a variance within 60 days of this permit reissuance, as noted in the permit cover letter, in accordance with s. 283.15, Stats.

If Adaptive Management or Water Quality Trading is approved as part of the permit application for the next reissuance or as part of an application for a modification or revocation and reissuance, the plan and specifications submittal, construction, and final effective dates for compliance with the total phosphorus WQBEL may change in the reissued or modified permit. In addition, the numeric value of the water quality based effluent limit may change based on new information (e.g. a TMDL) or additional data. If a variance is approved for the next reissuance, interim limits and conditions will be imposed in the reissued permit in accordance with s. 283.15, Stats., and applicable regulations. A permittee may apply for a variance to the phosphorus WQBEL at the next reissuance even if the permittee did not apply for a phosphorus variance as part of this permit reissuance.

Additional Requirements: If a water quality based effluent limit has taken effect in a permit, any increase in the limit is subject to s. NR 102.05(1) and ch. NR 207, Wis. Adm. Code. When a six-month average effluent limit is specified for Total Phosphorus the applicable averaging periods are May through October and November through April.

*Note: The Department will prioritize reissuances and revocations, modifications, and reissuances of permits to allow permittees the opportunity to implement adaptive management or nutrient trading in a timely and effective manner.

3.2.1.7 Alternative Approaches to Phosphorus WQBEL Compliance

Rather than upgrading its wastewater treatment facility to comply with WQBELs for total phosphorus, the permittee may use Water Quality Trading or the Watershed Adaptive Management Option, to achieve compliance under ch. NR 217, Wis. Adm. Code, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. The permittee may also implement an upgrade to its wastewater treatment facility in combination with Water Quality Trading or the Watershed Adaptive Management Option to achieve compliance, provided that the permit is modified, revoked and reissued, or reissued to incorporate any such alternative approach. If the Final Compliance Alternatives Plan concludes that a variance will be pursued, the Plan shall provide information regarding the basis for the variance.

3.2.1.8 Submittal of Permit Application for Next Reissuance and Adaptive Management or Pollutant Trading Plan or Variance Application

The permittee shall submit the permit application for the next reissuance at least 6 months prior to expiration of this permit. If the permittee intends to pursue adaptive management to achieve compliance with the phosphorus water quality based effluent limitation, the permittee shall submit with the application for the next reissuance: a completed Watershed Adaptive Management Request Form 3200-139, the completed Adaptive Management Plan and final plans for any system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code. If the permittee intends to pursue pollutant trading to achieve compliance, the permittee shall submit an application for water quality trading with the application for the next reissuance. If system upgrades will be used in combination with pollutant trading to achieve compliance with the final water quality-based limit, the reissued permit will specify a schedule for the necessary upgrades. If the permittee intends to seek a variance, the permittee shall submit an application for a variance with the application for the next reissuance.

3.2.1.9 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Mississippi River, upstream of discharge

Instream Waste Concentration (IWC): 1.8%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted [choose one: once every other year, once each year, twice each year, quarterly, or bimonthly] in rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute Tests:**
 - July – Sept 2016
 - Oct – Dec 2017
 - Jan – March 2018
 - April – June 2019
 - July – Sept 2020

Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the fourth calendar year of this permit. For example, the next test would be required in Oct-Dec 2021.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: If $LC_{50} \geq 100$, then $TU_a = 1.0$. If LC_{50} is < 100 , then $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Relative Toxic Unit - Chronic (rTU_c) is greater than 1.0 for either species. The rTU_c shall be calculated as follows: If $IC_{25} \geq IWC$, then $rTU_c = 1.0$. If $IC_{25} < IWC$, then $rTU_c = IWC \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90 day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

4 Land Application Requirements

4.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	Sampling Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)
002	Representative cake sludge samples shall be collected prior to land application. Sludge must be mixed prior to sampling and monitored bimonthly for lists 1, 2, 3, and 4, and once in 2016 for PCBs.
003	Representative liquid sludge samples shall be collected from the sludge storage discharge. Sludge must be mixed prior to sampling, and monitored bimonthly for lists 1, 2, 3, and 4, and once in 2016 for PCBs.

4.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

4.2.1 Sampling Point (Outfall) 002 - CAKE SLUDGE and 003- LIQUID SLUDGE

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Solids, Total		Percent	1/ 2 Months	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	High Quality	300 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	1/ 2 Months	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	1/ 2 Months	Composite	
Nitrogen, Total Kjeldahl		Percent	1/ 2 Months	Composite	
Nitrogen, Ammonium (NH ₄ -N) Total		Percent	1/ 2 Months	Composite	
Phosphorus, Total		Percent	1/ 2 Months	Composite	

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Phosphorus, Water Extractable		% of Tot P	1/ 2 Months	Composite	
Potassium, Total Recoverable		Percent	1/ 2 Months	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Once in 2016.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Once in 2016.

Other Sludge Requirements	
Sludge Requirements	Sample Frequency
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	BiMonthly
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	BiMonthly

4.2.1.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

4.2.1.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

4.2.1.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

4.2.1.4 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

$$[(\text{Pollutant concentration (mg/kg)} \times \text{dry tons applied/ac}) \div 500] + \text{previous loading (lbs/acre)} = \text{cumulative lbs pollutant per acre}$$

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

4.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during 2016. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

4.2.1.6 Lists 1, 2, 3, and 4

List 1 TOTAL SOLIDS AND METALS
See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 NUTRIENTS
See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH ₄ -N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3

PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform *	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion		Air Drying
Anaerobic Digestion		Composting
Alkaline Stabilization		PSRP Equivalent Process

* The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4

VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O ₂ /hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

4.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations		
The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements.		
Parameters	Units	Sample Frequency
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

* gallons, cubic yards, dry US Tons or dry Metric Tons

4.2.2 Sampling Point (Outfall) 003 - LIQUID SLUDGE

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Solids, Total		Percent	1/ 2 Months	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	1/ 2 Months	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	1/ 2 Months	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	1/ 2 Months	Composite	
Lead Dry Wt	High Quality	300 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	1/ 2 Months	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	1/ 2 Months	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	1/ 2 Months	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	1/ 2 Months	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	1/ 2 Months	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	1/ 2 Months	Composite	
Nitrogen, Total Kjeldahl		Percent	1/ 2 Months	Composite	

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Nitrogen, Ammonium (NH ₄ -N) Total		Percent	1/ 2 Months	Composite	
Phosphorus, Total		Percent	1/ 2 Months	Composite	
Phosphorus, Water Extractable		% of Tot P	1/ 2 Months	Composite	
Potassium, Total Recoverable		Percent	1/ 2 Months	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	

Other Sludge Requirements	
Sludge Requirements	Sample Frequency
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	Annual
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	Annual

4.2.2.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

4.2.2.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

4.2.2.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

4.2.2.4 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

$$[(\text{Pollutant concentration (mg/kg)} \times \text{dry tons applied/ac}) \div 500] + \text{previous loading (lbs/acre)} = \text{cumulative lbs pollutant per acre}$$

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

4.2.2.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during 2016. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

4.2.2.6 Lists 1, 2, 3, and 4

List 1 TOTAL SOLIDS AND METALS
See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 NUTRIENTS
See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH ₄ -N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3

PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform *	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion		Air Drying
Anaerobic Digestion		Composting
Alkaline Stabilization		PSRP Equivalent Process

* The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4

VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O ₂ /hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

4.2.2.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations		
<p>The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements.</p>		
Parameters	Units	Sample Frequency
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

* gallons, cubic yards, dry US Tons or dry Metric Tons

5 Schedules

5.1 Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus

The permittee shall comply with the WQBELs for Phosphorus as specified. No later than 30 days following each compliance date, the permittee shall notify the Department in writing of its compliance or noncompliance. If a submittal is required, a timely submittal fulfills the notification requirement.

Required Action	Due Date
<p>Operational Evaluation Report: The permittee shall prepare and submit to the Department for approval an operational evaluation report. The report shall include an evaluation of collected effluent data, possible source reduction measures, operational improvements or other minor facility modifications that will optimize reductions in phosphorus discharges from the treatment plant during the period prior to complying with final phosphorus WQBELs and, where possible, enable compliance with final phosphorus WQBELs by 01/01/2019. The report shall provide a plan and schedule for implementation of the measures, improvements, and modifications as soon as possible, but not later than 01/01/2019 and state whether the measures, improvements, and modifications will enable compliance with final phosphorus WQBELs. Regardless of whether they are expected to result in compliance, the permittee shall implement the measures, improvements, and modifications in accordance with the plan and schedule specified in the operational evaluation report.</p> <p>If the operational evaluation report concludes that the facility can achieve final phosphorus WQBELs using the existing treatment system with only source reduction measures, operational improvements, and minor facility modifications, the permittee shall comply with the final phosphorus WQBEL by 01/01/2019 and is not required to comply with the milestones identified below for years 3 through 9 of this compliance schedule ('Preliminary Compliance Alternatives Plan', 'Final Compliance Alternatives Plan', 'Final Plans and Specifications', 'Treatment Plant Upgrade to Meet WQBELs', 'Complete Construction', 'Achieve Compliance').</p> <p>STUDY OF FEASIBLE ALTERNATIVES - If the Operational Evaluation Report concludes that the permittee cannot achieve final phosphorus WQBELs with source reduction measures, operational improvements and other minor facility modifications, the permittee shall initiate a study of feasible alternatives for meeting final phosphorus WQBELs and comply with the remaining required actions of this schedule of compliance. If the Department disagrees with the conclusion of the report, and determines that the permittee can achieve final phosphorus WQBELs using the existing treatment system with only source reduction measures, operational improvements, and minor facility modifications, the Department may reopen and modify the permit to include an implementation schedule for achieving the final phosphorus WQBELs sooner than 01/01/2025.</p>	01/01/2017
<p>Compliance Alternatives, Source Reduction, Improvements and Modifications Status: The permittee shall submit a 'Compliance Alternatives, Source Reduction, Operational Improvements and Minor Facility Modification' status report to the Department. The report shall provide an update on the permittee's: (1) progress implementing source reduction measures, operational improvements, and minor facility modifications to optimize reductions in phosphorus discharges and, to the extent that such measures, improvements, and modifications will not enable compliance with the WQBELs, (2) status evaluating feasible alternatives for meeting phosphorus WQBELs.</p>	01/01/2018
<p>Preliminary Compliance Alternatives Plan: The permittee shall submit a preliminary compliance alternatives plan to the Department.</p> <p>If the plan concludes upgrading of the permittee's wastewater treatment facility is necessary to achieve final phosphorus WQBELs, the submittal shall include a preliminary engineering design report.</p>	01/01/2019

<p>If the plan concludes Adaptive Management will be used, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 without the Adaptive Management Plan.</p> <p>If water quality trading will be undertaken, the plan must state that trading will be pursued.</p>	
<p>Final Compliance Alternatives Plan: The permittee shall submit a final compliance alternatives plan to the Department.</p> <p>If the plan concludes upgrading of the permittee's wastewater treatment is necessary to meet final phosphorus WQBELs, the submittal shall include a final engineering design report addressing the treatment plant upgrades, and a facility plan if required pursuant to ch. NR 110, Wis. Adm. Code.</p> <p>If the plan concludes Adaptive Management will be implemented, the submittal shall include a completed Watershed Adaptive Management Request Form 3200-139 and an engineering report addressing any treatment system upgrades necessary to meet interim limits pursuant to s. NR 217.18, Wis. Adm. Code.</p> <p>If the plan concludes water quality trading will be used, the submittal shall identify potential trading partners.</p> <p>Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	01/01/2020
<p>Progress Report on Plans & Specifications: Submit progress report regarding the progress of preparing final plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	01/01/2021
<p>Final Plans and Specifications: Unless the permit has been modified, revoked and reissued, or reissued to include Adaptive Management or Water Quality Trading measures or to include a revised schedule based on factors in s. NR 217.17, Wis. Adm. Code, the permittee shall submit final construction plans to the Department for approval pursuant to s. 281.41, Stats., specifying treatment plant upgrades that must be constructed to achieve compliance with final phosphorus WQBELs, and a schedule for completing construction of the upgrades by the complete construction date specified below. (Note: Permit modification, revocation and reissuance, and reissuance are subject to s. 283.53(2), Stats.)</p> <p>Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	01/01/2022
<p>Treatment Plant Upgrade to Meet WQBELs: The permittee shall initiate construction of the upgrades. The permittee shall obtain approval of the final construction plans and schedule from the Department pursuant to s. 281.41, Stats. Upon approval of the final construction plans and schedule by the Department pursuant to s. 281.41, Stats., the permittee shall construct the treatment plant upgrades in accordance with the approved plans and specifications. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	04/01/2022
<p>Construction Upgrade Progress Report #1: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	04/01/2023
<p>Construction Upgrade Progress Report #2: The permittee shall submit a progress report on construction upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	04/01/2024
<p>Complete Construction: The permittee shall complete construction of wastewater treatment system upgrades. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	12/31/2024

<p>Achieve Compliance: The permittee shall achieve compliance with final phosphorus WQBELs. Note: See 'Alternative Approaches to Phosphorus WQBEL Compliance' in the Surface Water section of this permit.</p>	<p>01/01/2025</p>
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5.2 Mercury Pollutant Minimization Program

The permittee shall implement or continue to implement a pollutant minimization program as defined in s. NR 106.145(7), Wis. Adm. Code.

Required Action	Due Date
<p>Submit Annual Status Reports: The permittee shall submit to the Department an annual status report on the progress of the PMP as required by s. NR 106.145(7), Wis. Adm. Code. Submittal of the first annual status report is required by the Date Due.</p> <p>Note: If the permittee wishes to apply for an alternative mercury effluent limitation, that application is due with the application for permit reissuance by 6 months prior to permit expiration. The permittee should submit or reference the PMP plan as updated by the Annual Status Report or more recent developments as part of that application.</p>	<p>04/01/2016</p>
<p>Submit Annual Status Report: Submit second annual status report.</p>	<p>04/01/2017</p>
<p>Submit Annual Status Report: Submit third annual status report.</p>	<p>04/01/2018</p>
<p>Submit Annual Status Report: Submit fourth annual status report.</p>	<p>04/01/2019</p>
<p>Submit Annual Status Report #5: Submit fifth annual status report.</p>	<p>04/01/2020</p>

5.3 Sludge Management Plan Update

This compliance schedule requires the permittee to achieve compliance by the specified date

Required Action	Due Date
<p>Sludge Management Plan Submittal: : The permittee shall submit to the Department an updated sludge management plan which shall include plans to provide additional sludge storage capacity.</p>	<p>03/31/2016</p>

6 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

6.1 Reporting and Monitoring Requirements

6.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR). The eDMR shall be certified electronically by a principal executive officer, a ranking elected official or other duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

6.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

6.1.3 Pretreatment Sampling Requirements

Sampling for pretreatment parameters (cadmium, chromium, copper, lead, nickel, zinc, and mercury) shall be done during a day each month when industrial discharges are occurring at normal to maximum levels. The sampling of the influent and effluent for these parameters shall be coordinated. All 24 hour composite samples shall be flow proportional.

6.1.4 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;
- the individual who performed the analysis;
- the analytical techniques or methods used; and
- the results of the analysis.

6.1.5 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.
- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.
- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD₅ and Total Suspended Solids shall be considered to be limits of quantitation
- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

6.1.6 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

A separate CMAR certification document, that is not part of the electronic report form, shall be mailed to the Department at the time of electronic submittal of the CMAR. The CMAR certification shall be signed and submitted by an authorized representative of the permittee. The certification shall be submitted by mail. The certification shall verify the electronic report is complete, accurate and contains information from the owner's treatment works.

6.1.7 Records Retention

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 the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

6.1.8 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 Department, it shall promptly submit such facts or correct information to the Department.

6.2 System Operating Requirements

6.2.1 Noncompliance Reporting

Sanitary sewer overflows and sewage treatment facility overflows shall be reported according to the 'Sanitary Sewer Overflows and Sewage Treatment Facility Overflows' section of this permit.

The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:

- any noncompliance which may endanger health or the environment;
- any violation of an effluent limitation resulting from a bypass;
- any violation of an effluent limitation resulting from an upset; and
- any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

A scheduled bypass approved by the Department under the 'Scheduled Bypass' section of this permit shall not be subject to the reporting required under this section.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. **The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at 1-800-943-0003.**

6.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

6.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-536, Wis. Adm. Code.

6.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

6.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

6.2.6 Bypass

This condition applies only to bypassing at a sewage treatment facility that is not a scheduled bypass, approved blending as a specific condition of this permit, a sewage treatment facility overflow or a controlled diversion as provided in the sections titled 'Scheduled Bypass', 'Blending' (if approved), 'SSO's and Sewage Treatment Facility Overflows' and 'Controlled Diversions' of this permit. Any other bypass at the sewage treatment facility is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve a bypass if the permittee demonstrates all the following conditions apply:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, 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 preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the Noncompliance Reporting section of this permit.

6.2.7 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the 'Controlled Diversions' section of this permit, the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee's written request for Department approval of a scheduled bypass shall demonstrate that the conditions for bypassing specified in the above section titled 'Bypass' are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

6.2.8 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation. Sewage treatment facilities that have multiple treatment units to treat variable or seasonal loading conditions may shut down redundant treatment units when necessary for efficient operation. The following requirements shall be met during controlled diversions:

- Effluent from the sewage treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion

shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;

- A controlled diversion does not include blending as defined in s. NR 210.03(2e), Wis. Adm. Code, and as may only be approved under s. NR 210.12. A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in sewage treatment facility records and such records shall be available to the department on request.

6.2.9 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. The wastewater treatment facility shall be under the direct supervision of a state certified operator as required in s. NR 108.06(2), Wis. Adm. Code. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, 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.

6.3 Sewage Collection Systems

6.3.1 Sanitary Sewage Overflows and Sewage Treatment Facility Overflows

6.3.1.1 Overflows Prohibited

Any overflow or discharge of wastewater from the sewage collection system or at the sewage treatment facility, other than from permitted outfalls, is prohibited. The permittee shall provide information on whether any of the following conditions existed when an overflow occurred:

- The sanitary sewer overflow or sewage treatment facility overflow was unavoidable to prevent loss of life, personal injury or severe property damage;
- There were no feasible alternatives to the sanitary sewer overflow or sewage treatment facility overflow such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or preventative maintenance activities;
- The sanitary sewer overflow or the sewage treatment facility overflow was caused by unusual or severe weather related conditions such as large or successive precipitation events, snowmelt, saturated soil conditions, or severe weather occurring in the area served by the sewage collection system or sewage treatment facility; and
- The sanitary sewer overflow or the sewage treatment facility overflow was unintentional, temporary, and caused by an accident or other factors beyond the reasonable control of the permittee.

6.3.1.2 Permittee Response to Overflows

Whenever a sanitary sewer overflow or sewage treatment facility overflow occurs, the permittee shall take all feasible steps to control or limit the volume of untreated or partially treated wastewater discharged, and terminate the discharge as soon as practicable. Remedial actions, including those in NR 210.21 (3), Wis. Adm. Code, shall be implemented consistent with an emergency response plan developed under the CMOM program.

6.3.1.3 Permittee Reporting

Permittees shall report all sanitary sewer overflows and sewage treatment overflows as follows:

- The permittee shall notify the department by telephone, fax or email as soon as practicable, but no later than 24 hours from the time the permittee becomes aware of the overflow;

- The permittee shall, no later than five days from the time the permittee becomes aware of the overflow, provide to the department the information identified in this paragraph using department form number 3400-184. If an overflow lasts for more than five days, an initial report shall be submitted within 5 days as required in this paragraph and an updated report submitted following cessation of the overflow. At a minimum, the following information shall be included in the report:
 - The date and location of the overflow;
 - The surface water to which the discharge occurred, if any;
 - The duration of the overflow and an estimate of the volume of the overflow;
 - A description of the sewer system or treatment facility component from which the discharge occurred such as manhole, lift station, constructed overflow pipe, or crack or other opening in a pipe;
 - The estimated date and time when the overflow began and stopped or will be stopped;
 - The cause or suspected cause of the overflow including, if appropriate, precipitation, runoff conditions, areas of flooding, soil moisture and other relevant information;
 - Steps taken or planned to reduce, eliminate and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
 - A description of the actual or potential for human exposure and contact with the wastewater from the overflow;
 - Steps taken or planned to mitigate the impacts of the overflow and a schedule of major milestones for those steps;
 - To the extent known at the time of reporting, the number and location of building backups caused by excessive flow or other hydraulic constraints in the sewage collection system that occurred concurrently with the sanitary sewer overflow and that were within the same area of the sewage collection system as the sanitary sewer overflow; and
 - The reason the overflow occurred or explanation of other contributing circumstances that resulted in the overflow event. This includes any information available including whether the overflow was unavoidable to prevent loss of life, personal injury, or severe property damage and whether there were feasible alternatives to the overflow.

NOTE: A copy of form 3400-184 for reporting sanitary sewer overflows and sewage treatment facility overflows may be obtained from the department or accessed on the department's web site at <http://dnr.wi.gov/topic/wastewater/SSOreport.html>. As indicated on the form, additional information may be submitted to supplement the information required by the form.

- The permittee shall identify each specific location and each day on which a sanitary sewer overflow or sewage treatment facility overflow occurs as a discrete sanitary sewer overflow or sewage treatment facility overflow occurrence. An occurrence may be more than one day if the circumstances causing the sanitary sewer overflow or sewage treatment facility overflow results in a discharge duration of greater than 24 hours. If there is a stop and restart of the overflow at the same location within 24 hours and the overflow is caused by the same circumstance, it may be reported as one occurrence. Sanitary sewer overflow occurrences at a specific location that are separated by more than 24 hours shall be reported as separate occurrences; and
- A permittee that is required to submit wastewater discharge monitoring reports under NR 205.07 (1) (r) shall also report all sanitary sewer overflows and sewage treatment facility overflows on that report.

6.3.1.4 Public Notification

The permittee shall notify the public of any sanitary sewer and sewage treatment facility overflows consistent with its emergency response plan required under the CMOM (Capacity, Management, Operation and Maintenance) section of this permit and s. NR 210.23 (4) (f), Wis. Adm. Code. Such public notification shall occur promptly following any overflow event using the most effective and efficient communications available in the community. At minimum, a

daily newspaper of general circulation in the county(s) and municipality whose waters may be affected by the overflow shall be notified by written or electronic communication.

6.3.2 Capacity, Management, Operation and Maintenance (CMOM) Program

- The permittee shall by August 1, 2016 submit to the Department verification that a CMOM program for the sewage collection system has been developed which is consistent with the requirements of NR 210.23, Wis. Adm. Code.
- The permittee shall develop and maintain written documentation of the CMOM program components, and shall verify each year with the submittal of the Compliance Maintenance Annual Report required under the 'Compliance Maintenance Annual Reports' section of this permit that the CMOM program documentation is current and meets the requirements in NR 210.23, Wis. Adm. Code.
- The permittee shall implement a CMOM program consistent with the permittee's program documentation and with the requirements of NR 210.23, Wis. Adm. Code.
- The permittee shall annually conduct a self-audit of activities to ensure the CMOM program is being implemented as necessary to meet the requirements contained in the CMOM program documentation.
- The permittee shall make available CMOM program documentation, a record of implementation activities and the results of the self-audit to the Department on request.

6.3.3 Sewer Cleaning Debris and Materials

All debris and material removed from cleaning sanitary sewers shall be managed to prevent nuisances, run-off, ground infiltration or prohibited discharges.

- Debris and solid waste shall be dewatered, dried and then disposed of at a licensed solid waste facility.
- Liquid waste from the cleaning and dewatering operations shall be collected and disposed of at a permitted wastewater treatment facility.
- Combination waste including liquid waste along with debris and solid waste may be disposed of at a licensed solid waste facility or wastewater treatment facility willing to accept the waste.

6.4 Surface Water Requirements

6.4.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

6.4.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

6.4.3 Effluent Temperature Requirements

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. ‘Cold Shock’ means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

6.4.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

6.4.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

- a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.
- b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.
- c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.
- d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

6.4.6 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD₅ and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total

suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

6.4.7 Fecal Coliforms

The limit for fecal coliforms shall be expressed as a monthly geometric mean.

6.4.8 Seasonal Disinfection

Disinfection shall be provided from May 1 through September 30 of each year. Monitoring requirements and the limitation for fecal coliforms apply only during the period in which disinfection is required. Whenever chlorine is used for disinfection or other uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used.

6.4.9 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition"* (PUB-WT-797, November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the *Ceriodaphnia dubia* and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

6.4.10 Whole Effluent Toxicity (WET) Identification and Reduction

This standard requirement applies only to acute or chronic WET monitoring that is not accompanied by a WET limit. Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;
- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including some or all of the following actions:
 - (a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
 - (b) Identify the compound(s) causing toxicity
 - (c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
 - (d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)
- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;
- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

6.5 Pretreatment Program Requirements

The permittee is required to operate an industrial pretreatment program as described in the program initially approved by the Department of Natural Resources including any subsequent program modifications approved by the Department, and including commitments to program implementation activities provided in the permittee's annual pretreatment program report, and that complies with the requirements set forth in 40 CFR Part 403 and ch. NR 211, Wis. Adm. Code. To ensure that the program is operated in accordance with these requirements, the following general conditions and requirements are hereby established:

6.5.1 Inventories

The permittee shall implement methods to maintain a current inventory of the general character and volume of wastewater that industrial users discharge to the treatment works and shall provide an updated industrial user listing annually and report any changes in the listing to the Department by March 31 of each year as part of the annual pretreatment program report required herein.

6.5.2 Regulation of Industrial Users

6.5.2.1 Limitations for Industrial Users:

The permittee shall develop, maintain, enforce and revise as necessary local limits to implement the general and specific prohibitions of the state and federal General Pretreatment Regulations.

6.5.2.2 Control Documents for Industrial Users (IUs)

The permittee shall control the discharge from each significant industrial user through individual discharge permits as required by s. NR 211.235, Wis. Adm. Code and in accordance with the approved pretreatment program procedures and the permittee's sewer use ordinance. The discharge permits shall be modified in a timely manner during the stated term of the discharge permits according to the sewer use ordinance as conditions warrant. The discharge permits shall include at a minimum the elements found in s. NR 211.235(1), Wis. Adm. Code and references to the approved pretreatment program procedures and the sewer use ordinance.

6.5.2.3 Review of Industrial User Reports, Inspections and Compliance Monitoring

The permittee shall require the submission of, receive, and review self-monitoring reports and other notices from industrial users in accordance with the approved pretreatment program procedures. The permittee shall randomly sample and analyze industrial user discharges and conduct surveillance activities to determine independent of information supplied by the industrial users, whether the industrial users are in compliance with pretreatment standards and requirements. The inspections and monitoring shall also be conducted to maintain accurate knowledge of local industrial processes, including changes in the discharge, pretreatment equipment operation, spill prevention control plans, slug control plans, and implementation of solvent management plans.

The permittee shall inspect and sample the discharge from each significant industrial user as specified in the permittee's approved pretreatment program or as specified in NR 211.235(3). The permittee shall evaluate whether industrial users identified as significant need a slug control plan according to the requirements of NR 211.235(4). If a slug control plan is needed, the plan shall contain at a minimum the elements specified in s. NR 211.235(4)(b), Wis. Adm. Code.

6.5.2.4 Enforcement and Industrial User Compliance Evaluation & Violation Reports

The permittee shall enforce the industrial pretreatment requirements including the industrial user discharge limitations of the permittee's sewer use ordinance. The permittee shall investigate instances of noncompliance by collecting and analyzing samples and collecting other information with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Investigation and response to instances of noncompliance shall be in accordance with the permittee's sewer use ordinance and approved Enforcement Response Plan.

The permittee shall make a semiannual report on forms provided or approved by the Department. The semiannual report shall include an analysis of industrial user significant noncompliance (i.e. the Industrial User Compliance Evaluation, also known as the SNC Analysis) as outlined in s. NR 211.23(1)(j), Wis. Adm. Code, and a summary of

the permittee's response to all industrial noncompliance (i.e. the Industrial User Violation Report). The Industrial User Compliance Evaluation Report shall include monitoring results received from industrial users pursuant to s. NR 211.15(1)-(5), Wis. Adm. Code. The Industrial User Violation Report shall include copies of all notices of noncompliance, notices of violation and other enforcement correspondence sent by the permittee to industrial users, together with the industrial user's response. The Industrial User Compliance Evaluation and Violation Reports for the period January through June shall be provided to the Department by September 30 of each year and for the period July through December shall be provided to the Department by March 31 of the succeeding year, unless alternate submittal dates are approved.

6.5.2.5 Publication of Violations

The permittee shall publish a list of industrial users that have significantly violated the municipal sewer use ordinance during the calendar year, in the largest daily newspaper in the area by March 31 of the following year pursuant to s. NR 211.23(1)(j), Wis. Adm. Code. A copy of the newspaper publication shall be provided as part of the annual pretreatment report specified herein.

6.5.2.6 Multijurisdictional Agreements

The permittee shall establish agreements with all contributing jurisdictions as necessary to ensure compliance with pretreatment standards and requirements by all industrial users discharging to the permittee's wastewater treatment system. Any such agreement shall identify who will be responsible for maintaining the industrial user inventory, issuance of industrial user control mechanisms, inspections and sampling, pretreatment program implementation, and enforcement.

6.5.3 Annual Pretreatment Program Report

The permittee shall evaluate the pretreatment program, and submit the Pretreatment Program Report to the Department on forms provided or approved by the Department by March 31 annually, unless an alternate submittal date is approved. The report shall include a brief summary of the work performed during the preceding calendar year, including the numbers of discharge permits issued and in effect, pollution prevention activities, number of inspections and monitoring surveys conducted, budget and personnel assigned to the program, a general discussion of program progress in meeting the objectives of the permittee's pretreatment program together with summary comments and recommendations.

6.5.4 Pretreatment Program Modifications

- **Future Modifications:** The permittee shall within one year of any revisions to federal or state General Pretreatment Regulations submit an application to the Department in duplicate to modify and update its approved pretreatment program to incorporate such regulatory changes as applicable to the permittee. Additionally, the Department or the permittee may request an application for program modification at any time where necessary to improve program effectiveness based on program experience to date.
- **Modifications Subject to Department Approval:** The permittee shall submit all proposed pretreatment program modifications to the Department for determination of significance and opportunity for comment in accordance with the requirements and conditions of s. NR 211.27, Wis. Adm. Code. Any substantial proposed program modification shall be subject to Department public noticing and formal approval prior to implementation. A substantial program modification includes, but is not limited to, changes in enabling legal authority to administer and enforce pretreatment conditions and requirements; significant changes in program administrative or operational procedures; significant reductions in monitoring frequencies; significant reductions in program resources including personnel commitments, equipment, and funding levels; changes (including any relaxation) in the local limitations for substances enforced and applied to users of the sewerage treatment works; changes in treatment works sludge disposal or management practices which impact the pretreatment program; or program modifications which increase pollutant loadings to the treatment works. The Department shall use the procedures outlined in s. NR

211.30, Wis. Adm. Code for review and approval/denial of proposed pretreatment program modifications. The permittee shall comply with local public participation requirements when implementing the pretreatment program.

6.5.5 Program Resources

The permittee shall have sufficient resources and qualified personnel to carry out the pretreatment program responsibilities as listed in ss. NR 211.22 and NR 211.23, Wis. Adm. Code.

6.6 Land Application Requirements

6.6.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

6.6.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

6.6.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

6.6.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report. The Characteristic Report Form 3400-49 shall be submitted electronically by January 31 following each year of analysis.

Following submittal of the electronic Characteristic Report Form 3400-49, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report is true, accurate and complete. The Lab Report must be sent directly to the facility's DNR sludge representative or basin engineer unless approval for not submitting the lab reports has been given.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

6.6.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:

Water Extractable Phosphorus (% of Total P) =

$$[\text{Water Extractable Phosphorus (mg/kg, dry wt)} \div \text{Total Phosphorus (mg/kg, dry wt)}] \times 100$$

6.6.6 Monitoring and Calculating PCB Concentrations in Sludge

When sludge analysis for "PCB, Total Dry Wt" is required by this permit, the PCB concentration in the sludge shall be determined as follows.

Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with the following provisions and Table EM in s. NR 219.04, Wis. Adm. Code.

- EPA Method 1668 may be used to test for all PCB congeners. If this method is employed, all PCB congeners shall be delineated. Non-detects shall be treated as zero. The values that are between the limit of detection and the limit of quantitation shall be used when calculating the total value of all congeners. All results shall be added together and the total PCB concentration by dry weight reported. **Note:** It is recognized that a number of the congeners will co-elute with others, so there will not be 209 results to sum.
- EPA Method 8082A shall be used for PCB-Aroclor analysis and may be used for congener specific analysis as well. If congener specific analysis is performed using Method 8082A, the list of congeners tested shall include at least congener numbers 5, 18, 31, 44, 52, 66, 87, 101, 110, 138, 141, 151, 153, 170, 180, 183, 187, and 206 plus any other additional congeners which might be reasonably expected to occur in the particular sample. For either type of analysis, the sample shall be extracted using the Soxhlet extraction (EPA Method 3540C) (or the Soxhlet Dean-Stark modification) or the pressurized fluid extraction (EPA Method 3545A). If Aroclor analysis is performed using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.11 mg/kg as possible. Reporting protocol, consistent with s. NR 106.07(6)(e), should be as follows: If all Aroclors are less than the LOD, then the Total PCB Dry Wt result should be reported as less than the highest LOD. If a single Aroclor is detected then that is what should be reported for the Total PCB result. If multiple Aroclors are detected, they should be summed and reported as Total PCBs. If congener specific analysis is done using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.003 mg/kg as possible for each congener. If the aforementioned limits of detection cannot be achieved after using the appropriate clean up techniques, a reporting limit that is achievable for the Aroclors or each congener for the sample shall be determined. This reporting limit shall be reported and qualified indicating the presence of an interference. The lab conducting the analysis shall perform as many of the following methods as necessary to remove interference:

3620C – Florisil

3640A - Gel Permeation

3630C - Silica Gel

3611B - Alumina

3660B - Sulfur Clean Up (using copper shot instead of powder)

3665A - Sulfuric Acid Clean Up

6.6.7 Annual Land Application Report

Land Application Report Form 3400-55 shall be submitted electronically by January 31, each year whether or not non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code. Following submittal of the electronic Annual Land Application Report Form 3400-55, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.8 Other Methods of Disposal or Distribution Report

The permittee shall submit electronically the Other Methods of Disposal or Distribution Report Form 3400-52 by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied. Following submittal of the electronic Report Form 3400-52, this form shall be certified electronically via the 'eReport Certify' page by a principal executive officer, ranking elected official or duly authorized representative. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.9 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

6.6.10 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

6.6.11 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

6.6.12 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.

Method 1:

$$\text{Geometric Mean} = (X_1 \times X_2 \times X_3 \dots \times X_n)^{1/n}$$

Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:

$$\text{Geometric Mean} = \text{antilog}[(X_1 + X_2 + X_3 \dots + X_n) \div n]$$

Where X = \log_{10} of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Example for Method 2

Sample Number	Coliform Density of Sludge Sample	\log_{10}
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the \log_{10} values of the coliform density and taking the antilog of that value.

$$(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) \div 7 = 5.98$$

$$\text{The antilog of } 5.98 = 9.5 \times 10^5$$

6.6.13 Vector Control: Volatile Solids Reduction

The mass of volatile solids in the sludge shall be reduced by a minimum of 38% between the time the sludge enters the digestion process and the time it either exits the digester or a storage facility. For calculation of volatile solids reduction, the permittee shall use the Van Kleeck equation or one of the other methods described in "Determination of Volatile Solids Reduction in Digestion" by J.B. Farrell, which is Appendix C of EPA's *Control of Pathogens in Municipal Wastewater Sludge* (EPA/625/R-92/013). The Van Kleeck equation is:

$$\text{VSR}\% = \frac{\text{VS}_{\text{IN}} - \text{VS}_{\text{OUT}}}{\text{VS}_{\text{IN}} - (\text{VS}_{\text{OUT}} \times \text{VS}_{\text{IN}})} \times 100$$

Where: VS_{IN} = Volatile Solids in Feed Sludge (g VS/g TS)

VS_{OUT} = Volatile Solids in Final Sludge (g VS/g TS)

VSR% = Volatile Solids Reduction, (Percent)

6.6.14 Class B Sludge - Vector Control: Injection

No significant amount of the sewage sludge shall be present on the land surface within one hour after the sludge is injected.

7 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Operational Evaluation Report	January 1, 2017	18
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Compliance Alternatives, Source Reduction, Improvements and Modifications Status	January 1, 2018	18
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Preliminary Compliance Alternatives Plan	January 1, 2019	18
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Compliance Alternatives Plan	January 1, 2020	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Progress Report on Plans & Specifications	January 1, 2021	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Final Plans and Specifications	January 1, 2022	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Treatment Plant Upgrade to Meet WQBELs	April 1, 2022	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #1	April 1, 2023	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Construction Upgrade Progress Report #2	April 1, 2024	19
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Complete Construction	December 31, 2024	20
Water Quality Based Effluent Limits (WQBELs) for Total Phosphorus - Achieve Compliance	January 1, 2025	20
Mercury Pollutant Minimization Program -Submit Annual Status Reports	April 1, 2016	20
Mercury Pollutant Minimization Program -Submit Annual Status Report	April 1, 2017	20
Mercury Pollutant Minimization Program -Submit Annual Status Report	April 1, 2018	20
Mercury Pollutant Minimization Program -Submit Annual Status Report	April 1, 2019	20
Mercury Pollutant Minimization Program -Submit Annual Status Report #5	April 1, 2020	20
Sludge Management Plan Update -Sludge Management Plan Submittal	March 31, 2016	20
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	22
Industrial User Compliance Evaluation and Violation Reports	Semiannual	31
Pretreatment Program Report	Annually	31
General Sludge Management Form 3400-48	prior to any significant sludge management changes	32

Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	32
Land Application Report Form 3400-55	by January 31, each year whether or not non-exceptional quality sludge is land applied	33
Report Form 3400-52	by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied	33
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	21

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:

West Central Region - LaCrosse, 3550 Mormon Coulee Road, La Crosse, WI 54601

Notes

Meeting 1 | August 15, 2018 | Issued August 27, 2018 – v1

Wastewater Facilities Plan
City of La Crosse, Wisconsin



These Notes document a Meeting that occurred on August 15, 2018. Please contact Eric Lynne (elynne@donohue-associates.com or 920-803-7375) with any comments or questions concerning these Notes.

Attendees

- Bernie Lenz, Utilities Manager, City
- Jared Greeno, Superintendent, City
- Brian Hein, Assistant Superintendent, City
- Greg Kozelek, Engineer, City
- Bill Marten, Donohue
- Jeremy Cramer, Donohue
- Mike Gerbitz, Donohue
- Jeff Wills, Donohue
- Joe Berktold, Donohue
- Eric Lynne, Donohue

Agenda

The Agenda that was distributed to the Attendees is attached to these Notes.

Notes

Note No.	Action By	Note
Administrative Matters		
1	Contact Information	<p>The people listed below will receive all email correspondence at the email addresses provided below.</p> <p>Email Addresses for Key Project Team Members</p> <ul style="list-style-type: none"> • Bernie Lenz lenzb@cityoflacrosse.org • Jared Greeno greenoja@cityoflacrosse.org • Bill Marten wmarten@donohue-associates.com • Eric Lynne elynne@donohue-associates.com • Mike Gerbitz mgerbitz@donohue-associates.com <p>Phone Numbers for Key Project Team Members</p> <ul style="list-style-type: none"> • Bernie Lenz (608) 789-7588 • Jared Greeno 608-789-7322 • Bill Marten 262-993-1581 • Eric Lynne 920-803-7375 • Mike Gerbitz 920-889-4000

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City of La Crosse, Wisconsin

- 2 Information All Key Project Team Members listed above will get all email correspondence, draft deliverables, and final deliverables. All Project emails should follow the subject line format shown below.
- La Crosse – WWFP – X where WWFP = wastewater facilities plan, and X = subject of particular email.
For example, La Crosse – WWFP – Digester Heating Data.
- 3 Donohue TM 3 will establish 20-year flows and loadings. This will require a service area population projection. Attendees recommended contacting the City Planning Department. Donohue will contact Jason Gilman. Bernie noted three distinct areas that are planned for expansion and of the regional connections, La Crescent is requesting more capacity, the rest are stable.
-

General Operation and Maintenance Information

- 4 Information The WWTP is staffed 1st shift weekdays, typically with 4 operators, 5 mechanics, 2 lab techs, 1 pretreatment coordinator, 1 electrician and 2 managers. It was noted the plant electrician maintains instrumentation & control (I&C) equipment and is in the process of learning I&C programming. It was also noted that an additional 8 work crew members handle City sewer maintenance.
- Due to the construction activity in and near La Crosse, the City has struggled to fill open positions.
- 5 Information Lab analyses are currently performed at the WWTP, with specialty analyses by Davy Labs.
- 6 The facility SCADA system (PLCs, Software, and Fiber Optic) was recently upgraded and the Staff have a lot of confidence in monitoring systems remotely via cell phones. The majority of callouts are related to vacuum prime lift stations or plugs on the screenings washpress.
- The City will consider the need for an improved operator station.
- A remotely visible camera to observe the 24/7 GBT operations enables users to start/stop/adjust the system from home.
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Wastewater Facilities Plan

City of La Crosse, Wisconsin

Existing Conditions

7	Information	<p>The information in this section attempts to briefly summarize the discussion related to present-day conditions, concerns, and preferred Facility improvements. These matters will be better defined and considered as alternatives and cost opinions are developed. See the attached presentation material for additional information and documentation. These Notes reflect input from the City.</p>
8	Information	<p>Site</p> <ul style="list-style-type: none">• Security adequate• Piping adequate, relined some critical lines• Odors Complaints typically due to City Brewery's facility• Parking adequate• Stormwater adequate
9	Information	<p>Administration Building</p> <ul style="list-style-type: none">• Lab adequate• Data Monitoring and Historian adequate• Operations Center adequate (door for desk)• Locker Rooms adequate• Storage adequate• Finishes and Features Administration building from 1930's retains much of the original character.• HVAC aging and inefficient• Training Room adequate, staff use the break room
10	Information	<p>Industrial Users</p> <ul style="list-style-type: none">• Industry meetings will be scheduled in the next couple weeks to discuss upcoming WWTP improvements/goals and obtain industry plans for growth/treatment goals.• Communication to the industries shall flow through Jared.• City Brewery, has pretreatment EQ tank and UASB digester. Facility had cogeneration, but was removed. Locally owned facility, makes a diverse portfolio of alcohol products. Growth of the brewery and observed loadings indicate the UASB is at/over capacity.<ul style="list-style-type: none">○ This plan must develop the cost for handling City Brewery's entire flow to contrast with their costs for treatment. Davy/Stover Engineering are

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Wastewater Facilities Plan
City of La Crosse, Wisconsin

developing estimated costs for improvements to the UASB system.

- Great Lakes Cheese, expanded in 2014 mostly makes cheese slices for Walmart and McDonalds. City was cleaning sewers regularly due to the high loading. Facility is adding pretreatment DAF to captures solids.
 - Kwik Trip, handles dairy product receipt and distribution to convenience stores. Adding bread and bun facility in 2018.
 - Trane, manufacturers HVAC equipment.
 - La Crosse Distilling Co., planned to open in 2018. City is concerned for loading/growth issues experienced in Baraboo. The current plan is for the industry to hold wastes and haul them offsite to a farm. Concerns with this concept may require an ability to accept this waste in the future.
-

Preliminary Treatment

- | | | |
|----|-------------|--|
| 11 | Information | <ul style="list-style-type: none">• 5MG of hauled in (septage/holding) wastes are dumped at the head of the plant. Grease loads are limited to weekday mornings to ensure operators are available to deal with debris or washpress alarms. Haulers have a gatepass now and a camera monitors activity (not recorded). A facility to receive these wastes and screen/pump the material to RWW or digestion is desired. This facility could also accept any local pretreatment facility waste sources.• No trucked leachate is received, but some does enter via the Onalaska collection system.• Some coal ash is received from Dairyland Power.• No influent flowmeter, no good place for it. Currently primary effluent or final effluent flow is used.• Peak flow was noted at 33 mgd during a 6-inch rain event in 2017, which was handled fine.• Grit deposits upstream of the comminutors and overwhelms the downstream systems every time the fine screen channel is taken offline.• Old comminutors should be replaced with a fine screen. City expressed interest towards a finer screening system as debris does make it through the existing ¼-inch step screen. |
|----|-------------|--|
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12	Information	Grit Process
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Wastewater Facilities Plan
City of La Crosse, Wisconsin

		<ul style="list-style-type: none">• Rotate operation of each grit basin every other day
		<p>Primary Settling</p>
13	Information	<ul style="list-style-type: none">• City uses their trucks to transfer approximately 4,000 gallons per week of brewery waste (retentate backwash, 350,000 mg/L COD) to supplement primary effluent BOD on weekends, holidays, and during facility shutdowns. The waste is stored at the plant in 2 approximately 3,000 gallon poly tanks.• This trucking effort is tolerable, but consideration could be given to installing a pipeline to improve this process as well as to handle increased transfers should the City decide to add this high COD brewery waste to the plant digesters as well as for a supplemental COD source for the Bio-P process.
		<p>Aeration Basins</p>
14	Information	<ul style="list-style-type: none">• Operate two trains of three basins with anaerobic and anoxic selectors for biological phosphorus removal.• Blowers were replaced in 2012. Typically operate with D.O.s in range of 3 mg/L - unable to operate at lower DOs due to aeration control system & blower constraints. Currently run 2 blowers to limit starts/stops.• Aeration valves cannot throttle lower than 19% open without concern for mixing limited conditions.
		<p>Secondary Settling</p>
15	Information	<ul style="list-style-type: none">• Concern regarding algae control in effluent weirs/launders.• Potential mixed liquor flow distribution imbalance into the secondary clarifiers.• No issues with RAS or WAS pumping. Sludge is wasted 10-15 minutes every hour. Plant staff control wasting based on SRT – target in range of 4.5-5 days recently.
		<p>UV</p>
16	Information	<ul style="list-style-type: none">• Wedeco system was installed in 2005. A third channel was added in 2008.• Parts availability is not a concern, City bought Waukesha's old system for parts.

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Wastewater Facilities Plan
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- Bulb/sleeve cleaning frequency has decreased since City Brewery switched from using Ferric Chloride for odor control (now use Hydrogen Peroxide).
-

Solids Handling

- | | | |
|----|-------------|--|
| 17 | Information | <ul style="list-style-type: none">• Solids handling is a main concern of the facility as it limits capacity, identified by the re-rate study.• Evident capacity improvement is to increase sludge concentration into the digesters. Other digester/sludge system capacity improvements need to be identified.• Digested Sludge (DSD) is thickened via Gravity Belt Thickener (GBT). DSD thickening was converted to 24/7 operation and it has helped stabilize/dampen the facility sidestream loadings.• Struvite is not a major concern. Some precipitation is observed as granules in the digesters/sludge, but not a problem with buildup in the piping. PVC filtrate lines are cleaned every 3-months. Ferric Chloride is dosed to the sidestream to control phosphorus. Sludge tubes in the heat exchanger have been replaced due to scaling.• Currently no digester mixing (just recirculation and transfer). The group discussed the options for digester mixing. The City was not in favor of linear motion mixing due to the cost of cover modifications needed, in particular on the existing digester covers.<ul style="list-style-type: none">○ Draft Tubes were noted to have good mixing modulation and redundancy, but require a crane for maintenance. The City noted crane rental is easy and cost effective from a local company.○ Pump/Nozzle mixing was noted to have good tolerance to varying liquid levels and skirted gas holder floating covers, but require a building for housing the pumps. |
|----|-------------|--|
-

Biogas

- | | | |
|----|-------------|---|
| 18 | Information | <ul style="list-style-type: none">• The existing sludge boilers utilize digester gas for heating the sludge and the digester complex. Substantial excess biogas is flared.• Potential exists for cogeneration facilities to burn biogas to produce electricity. The City is OK with adding this extra equipment if done properly and with a maintenance contract to limit/minimize any added O&M burden to the existing (limited) staff. |
|----|-------------|---|
-

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City of La Crosse, Wisconsin

- A biogas line was routed to the admin building for potential use in the house boilers
 - Biogas storage is currently limited, and the City's preference would be for a low-pressure slab on grade biogas storage membrane. This decouples the gas storage from digester maintenance.
-

Cake Storage

19 Information

- BFP operation produces 15-18% TS cake solids when generated from sludge storage, but typically 20-23% when generated directly from the secondary digester.
 - BFP operation is not efficient with equipment separated from the cake storage location.
 - Use of a solar (greenhouse) sludge dryer was noted to be a high-potential alternative to increase the capacity of the existing cake storage building, while improving land application and public acceptance.
-

Biosolids Land Application

20 Information

- Typically 6 MG of liquid sludge is applied to farm fields spring and fall by a 5-year contract with Synagro. Can haul 350,000 gal per day, but this still requires several weeks to empty storage; which is very vulnerable to adverse weather. Hauling extends 20 miles towards the Bangor area. Synagro handles the land application paperwork and field approvals.
 - Cake biosolids are only produced after the liquid sludge storage tanks are full or to land apply to summer crops (i.e., alfalfa).
 - Most farmers prefer liquid as it has less odor (incorporated upon application) and less time is spent at each field to cause complaints.
 - Local governments (Town of Washington, Trempealeau County) have attempted to ban spreading municipal sludge but have not been successful.
 - Concern for phosphorus based nutrient management plans limiting land application and increasing required acreage.
 - Concern if continued or expanded liquid storage is the most sustainable path forward.
 - Additional approved acres in Minnesota have improved the land application concept. Potential for biosolids
-

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Wastewater Facilities Plan

City of La Crosse, Wisconsin

		<p>storage at a remote site. This should be discussed with MPCA.</p> <ul style="list-style-type: none">• Concern for debris in biosolids. Had an incident where landowner observed debris and risked degraded public relations and future land application acres. Consider a sludge screen.• Contact Synagro for feedback on marketability impact of potential biosolids changes (cake sludge, dried sludge, Class A sludge, struvite granules, Lystek, land/ag control methods)
		Miscellaneous
21	Information	<ul style="list-style-type: none">• Public Relations, the City hosts more than 70 tours to the public each year. The City will consider the need for improved facilities (display, etc.) to explain the facility.
		Future Regulations
22	Information	<ul style="list-style-type: none">• Total Nitrogen limits are anticipated to be the next regulation beyond phosphorus. The group discussed the fact that non-point sources would be a target for reductions. Additionally, noted potential coverage available by converting the existing system to the UCT process and that simultaneous nitrification and denitrification provides a high level of cost effective nitrogen removal. Nitrogen limits lower than this technology would require major legislative action and long term compliance schedules.
		Safety
23	Information	<ul style="list-style-type: none">• Donohue will review NFPA 820 recommendations from 2010 and update them to reflect proposed process changes.• The City had an arc flash study performed recently. City to provide a copy to Donohue.
24	City	City to provide instantaneous peak flow data during recent high flow event.
		Funding
25	Information	<ul style="list-style-type: none">• City plans to use Clean Water Fund SRF funding for the next major improvement project related to phosphorus and any other near term improvements. The subsidized

Notes

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City of La Crosse, Wisconsin

		<p>interest will be limited slightly due to the university/ industrial contribution.</p> <ul style="list-style-type: none">• Guaranteed savings project funding opportunities from Johnson Controls Inc. will likely fund energy savings projects (i.e., cogeneration).• The latest rate change was in 2015. Trilogy performed the most recent rate study.• The City is reviewing impact fees for new connections.• The City's replacement and O&M funds are healthy. The City felt as though revenue/expenses are neutral currently and any project would require a rate increase. Tina Erickson is the contact person for finances, but discussions would flow through Jared.• Phosphorus specific improvements should be tracked/quantified separately to manage a rate increase specific to this regulation change.
26	City	<p>A list of previously recommended improvements from past studies performed by Donohue was provided at the meeting. The City will review this list and provide feedback towards items already implemented or no longer applicable.</p>
27	Information	<p>Examples of alternatives evaluation criteria were provided to describe the ability to select best-overall alternatives using both economic and non-economic factors. The City was in favor of this for complicated alternatives.</p> <p>The evaluation criteria should be discussed with the City Sustainability Coordinator as it progresses.</p>
28	Information	<p>Schedule was discussed. The City plans to submit Notice Of Intent to Apply for Clean Water Fund funding/principal forgiveness by October 31, 2018. The evaluation of alternatives will need to be substantially complete by this time to apply a relatively accurate cost opinion and project description.</p> <p>The final plan will be provided by end of 2018, with City review incorporated before presenting to the January Committee of the Whole and February Council approval meetings. Committee meetings occur the Tuesday before the Council meetings which are on the 2nd Thursday of the month.</p>
<hr/> <p>End</p> <hr/>		

Technical Memorandum 2
Existing Conditions
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
Eric Lynne – Donohue & Associates
Ben Stephens – Donohue & Associates

Purpose

This Technical Memorandum (TM 2) documents the following items for the existing Isle La Plume Wastewater Treatment Facility:

- Overview of Existing Wastewater Treatment Facility
- WPDES Permit
- Plant Loadings & Performance
- Facility Issues & Observations

Existing Wastewater Treatment Facility

The Sanitary Sewer Utility for the City of La Crosse operates the Isle La Plume Wastewater Treatment Facility (WWTF). This WWTF is a regional facility that receives wastewater from the City of La Crosse and surrounding areas in Minnesota and Wisconsin. Adjacent entities served by the Sanitary Sewer Utility include the City of Onalaska, WI, the City of La Crescent, MN, the Town of Campbell, WI, and two sanitary districts that include parts of the Town of Shelby, WI. Service to these entities is provided according to a contract negotiated with each one.

The Utility was formed in July 1991. In addition to the Isle La Plume WWTF, the Utility is responsible for 26 sanitary lift stations and 188 miles of sanitary sewers that make up the wastewater collection system for the City of La Crosse. The Sanitary Sewer Utility also operates and maintains 7 storm water lift station and 134 miles of storm sewers. A smaller treatment facility on Barron Island was taken out of service in March of 2009. Customers served by the Barron Island facility connected to the La Crescent/La Crosse forcemain.

The facility was originally constructed on Isle La Plume in 1936 and has been upgraded several times since then. Capacity of the WWTF was doubled and secondary treatment added in 1972. Significant

additions and upgrades made since 1972 include replacement of chlorine disinfection with ultraviolet disinfection; upgrading the secondary treatment system to perform biological phosphorous removal; enhance aeration efficiency; upgrade of biosolids dewatering and construction of biosolids storage facilities; and upgrades to the screening and grit removal systems.

Figure 1 presents a process flow diagram of the plant. The liquid treatment train consists of fine screening, grit removal, primary settling, activated sludge configured to achieve biological phosphorous removal, secondary settling, and ultraviolet disinfection. The solids handling treatment train consists of co-thickening of primary sludge and waste activated sludge (WAS) in gravity thickeners, and anaerobic digestion. The digested sludge, termed biosolids, are either thickened using gravity belt thickeners or dewatered using a belt filter press. Liquid and dewatered biosolids are stored onsite prior to being recycled on agricultural land. The other residual material produced at the plant, from raw wastewater screening and grit removal, is disposed of by landfilling.

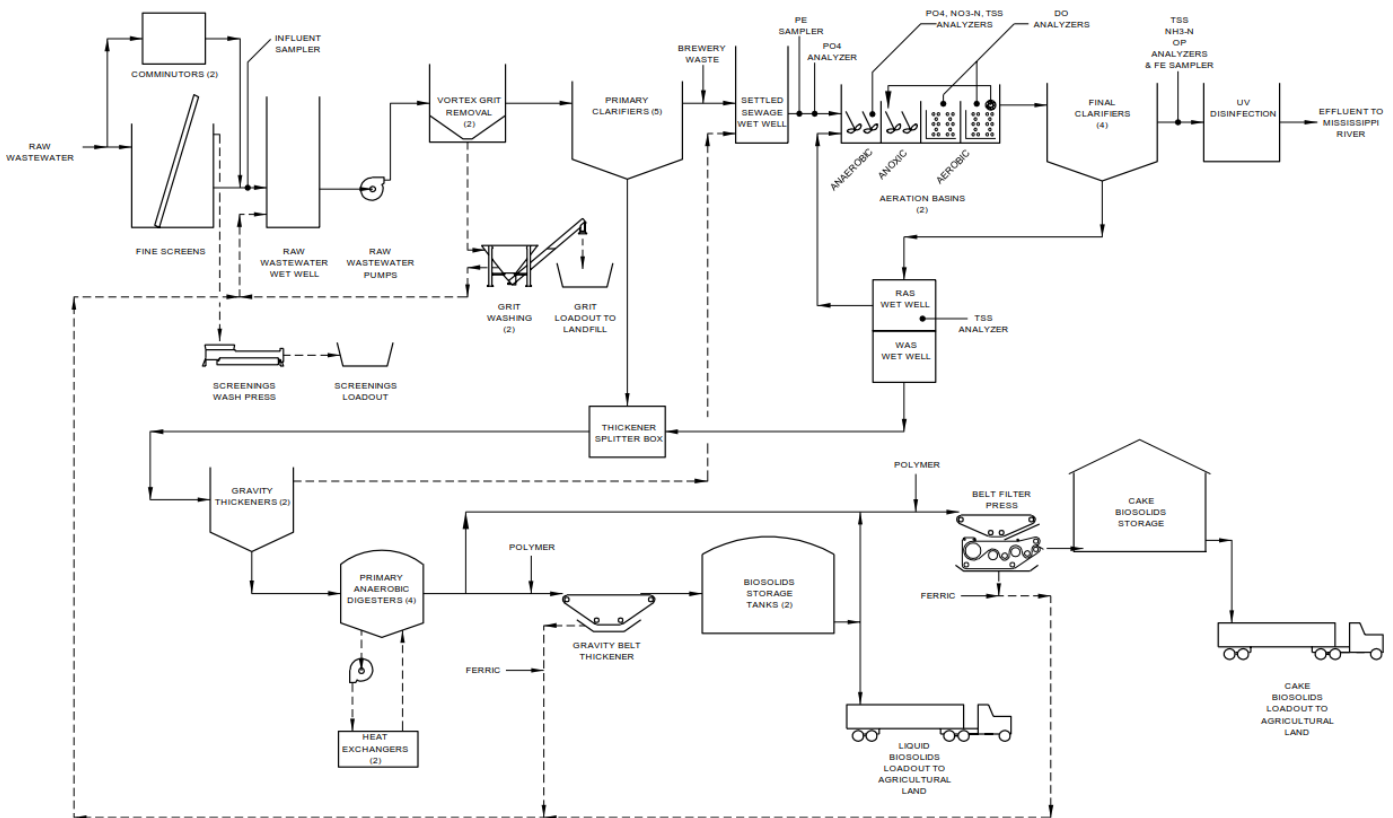


Figure 1 - Isle La Plume WWTF Flow Schematic

Although well maintained, a significant portion of the City’s wastewater infrastructure is relatively old and likely nearing the end of its useful life. To avoid costly repairs or risk inadequate treatment performance, the City initiated this study to evaluate and develop a planned approach towards equipment replacement and to plan for major improvements in the future.

The following sections provide brief discussions of these unit processes.

Preliminary Treatment

Influent wastewater is screened with a ¼-inch mechanical fine screen, which has a washer and compactor to process the screenings. The processed screenings are discharged into a dumpster and disposed of in a landfill. Two comminutors provide redundancy for the one mechanical screen.

The screened wastewater is pumped by the plant's raw wastewater pumps to one of two vortex grit basins. The removed grit is pumped to a grit washer and discharged into a dumpster prior to landfill disposal. The grit basin in service is rotated daily.



Figure 2 - Grit Classifier

Primary Treatment

There are a total of five primary clarifiers. Two rectangular clarifiers, which are 112 feet long by 26 feet wide, were part of the original plant construction. The third clarifier is 90-feet in diameter and was added when the facility was expanded in the 1950's. The newest clarifiers were added in the 1970's and are both 90-feet in diameter. Elevations of the effluent weirs in the rectangular clarifiers are approximately 6-inches higher than the circular clarifiers, which is attributed to differences in the influent hydraulics to the rectangular clarifiers. Current operational practice is to use the two newer circular clarifiers, while the older clarifier system is kept offline and only used to equalize downstream forward flows during periodic maintenance.

Primary effluent flows to the Settled Sewage Wet Well where it merges with gravity thickener overflow. Online analyzers monitor the condition of the primary effluent phosphorus concentrations to assist with decisions on how to manage nutrient removal. The facility's hydraulic profile is relatively flat, which requires pumps to lift the forward flow to the secondary treatment system.

Primary sludge and scum is pumped to the gravity thickener splitter box using dedicated plunger pumps.

Secondary Treatment

The activated sludge process consists of two parallel BNR process trains of anaerobic, anoxic, and aerobic zones to achieve secondary treatment and biological nutrient removal in the form of year-round biological phosphorus removal (BPR) and seasonal ammonia nitrogen removal through nitrification during portions of the year.

The BNR system is configured for the A2O process where primary effluent first mixes with return activated sludge (RAS) in an anaerobic zone, mixed with submersible mixers, where the nitrate in the RAS is quickly denitrified. With such denitrification complete the process goal is that there are sufficient volatile fatty acids (VFAs) remaining to allow the first step in enhanced biological phosphorus (P) removal (EBPR or Bio-P) to occur, that being phosphorus release while VFAs are taken up by the phosphorus accumulating organisms (PAOs). The PAOs, responsible for Bio-P, break internally stored polyphosphate molecules releasing orthophosphate into solution, and by doing so gain a small amount of energy just sufficient to take up and store the VFAs.

Following the anaerobic zone, the mixed liquor flows into another anaerobic zone (also mixed by submersible mixers) – the anoxic zone. In this zone effluent from the aeration tanks is recycle pumped

back to the beginning of this zone to promote biological denitrification of the nitrified mixed liquor. The key to this step is recycling a large amount of the nitrified mixed liquor, such that the overall nitrate content of the mixed liquor exiting the aeration basins and flowing to the final clarifiers is minimized as much as possible. By minimizing the nitrate in the aeration effluent the nitrate content of the RAS is also minimized, thus reducing the amount of VFAs in the primary effluent that are lost to denitrification in the anaerobic zone – and hopefully helping to optimize the first step of Bio-P.

The mixed liquor exiting the anoxic zone enters the aeration basins/aerobic zones, where fine bubble membrane diffusers provide aerobic conditions during which the following key activities occur:

- The biomass stabilizes/treats the waste in the primary effluent, often measured by a greater than 90% reduction in primary effluent BOD concentration.
- Ammonia nitrogen is oxidized by special, aerobic bacteria termed nitrifiers, converted biologically to nitrate nitrogen (a portion of which is recycled to the anoxic zones as noted above, in an attempt to minimize nitrate in the RAS).
- Excess biological uptake of phosphorus by the PAOs occurs – these Bio-P organisms take up excess orthophosphate, beyond what is needed for normal cell growth and reproduction, and store the excess as polyphosphate molecules within their cell bodies. This excess P uptake represents a key to EBPR – growing a microbial population that contains excess P, beyond that needed for cell growth/reproduction. But the other key to EBPR comes in waste activated sludge (WAS) – the only way P removal actually occurs through Bio-P is by wasting these phosphorus rich microorganisms from the system.

The air for the aeration basins is supplied by high-speed, air-bearing, turbo blowers. To balance airflow to the tanks, a single electric modulating butterfly valve is throttled on one of three main supply lines, the remaining lines have manual control valves. The facility commonly operates with excess dissolved oxygen (DO) deliberately to help avoid excessive ON/OFF cycling of the blowers.

In total, 50% of the plant's total bioreactor tank volume (2.5 million gallons) is operated as unaerated selectors (split evenly between anaerobic and anoxic zones) and 50% (2.5 million gallons) comprises the downstream aeration basin bioreactor zones.

The City's wastewater characteristics are normally favorable for Bio-P, with sufficient VFAs to denitrify the RAS and still have enough left over in the anaerobic zones for the PAOs. However the City has found the need to add supplemental carbon (VFAs) at times on weekends or when industrial shutdowns occur, to stabilize the system's biological phosphorus removal performance. The facility uses an online Chem-Scan analyzer to monitor insitu phosphorus and nitrate values of the anaerobic selector zone. This data is used by staff to react to upset conditions for adding carbon source or ferric chloride for phosphorus control.

The aerobic zones are supplied oxygen with fine bubble diffused air membranes.

The aerated mixed liquor suspended solids (MLSS) flows to a distribution chamber with submerged gates that isolate flow to each clarifier. The MLSS enters one of four, 120-foot diameter, circular clarifiers, where the biomass settles to the bottom and the clarified effluent flows up and over a peripheral v-notch weir. Algae growth on the clarifier effluent weirs and launders is significant and requires frequent cleaning to prevent nuisance algae in the final effluent.

The settled sludge is withdrawn from the bottom of each tank using siphon draft tube mechanisms and flows to a common sludge well. Three RAS pumps pump the biomass back to the anaerobic zones. Historical RAS flows exhibit a range of 40% to 120% of forward flow, with an average rate of 75%. Staff routinely monitor the mixed liquor settle-ability as documented by the sludge volume index (SVI). Historical SVI data ranges from 65 mL/g to 160 mL/g, with an average value of 110 mL/g.



Figure 3 - Final Clarifier Mechanism

A portion of the RAS is diverted out of the system as waste activated sludge to maintain efficient biological treatment. WAS is pumped to the gravity thickeners 10-15 minutes every hour, with the amount wasted determined by the aerobic solids retention time (SRT) with a typical target range of 3-6 days, with higher mass carried through the winter to promote nitrification.

A process model of the existing wastewater treatment facility and solids handling process was developed in 2008 as part of the previous facilities planning effort. A schematic of the process model is presented in Figure 4. This calibrated process model was also used to develop and assess optimization concepts for the phosphorus removal requirements. The model will again be utilized to assess the treatment impacts associated with proposed changes in subsequent phases of this facilities plan.

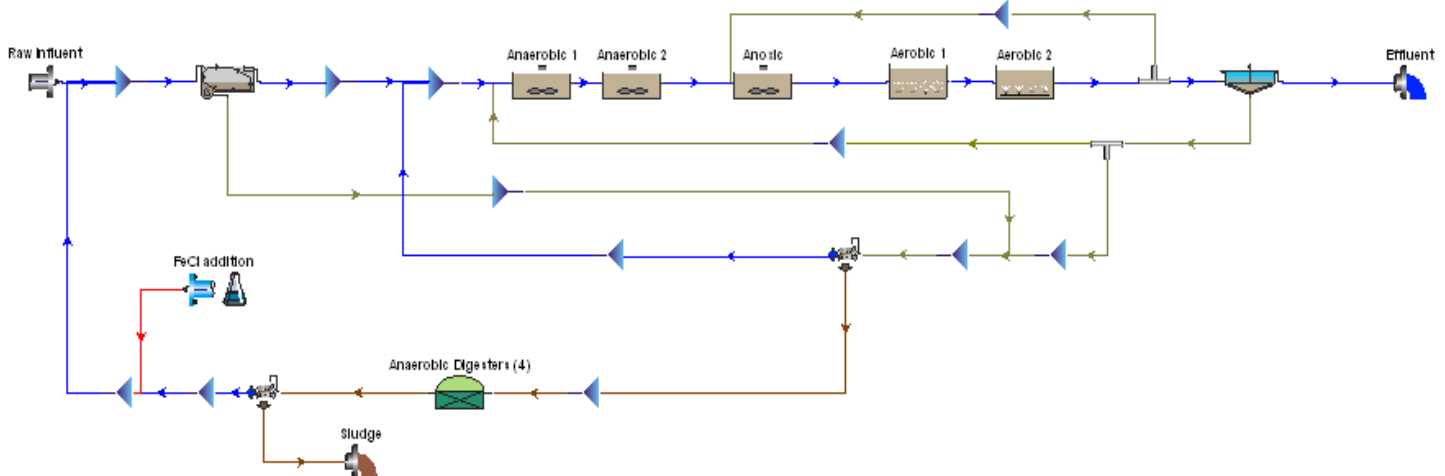


Figure 4 – Process Model for Isle La Plume WWTF

Disinfection

Ultraviolet (UV) light is used to disinfect the secondary effluent by inactivating cellular reproduction, which reduces the fecal coliform count in the treated wastewater prior to discharge. The three UV banks are sized for 42 mgd. The Ozonia UV system was installed in 2004 but was noted as difficult to obtain replacement parts. The City has proactively purchased an additional system, to use for spare parts, from the City of Waukesha WWTF (who had removed it and replaced it with a new system).

Raw Sludge Thickening

WAS and primary sludge are combined prior to thickening in two circular, 50-foot diameter gravity thickeners. The potential exists for the combined sludges to strip phosphate from the Bio-P WAS due to fermented, VFA-rich material in the primary sludge and the anaerobic conditions in the thickeners. Based on the tank volume and average underflow rates, the sludge inside the thickeners has an estimated detention time of 1-2 days.

The thickened sludge underflow from the gravity thickeners averages 2.8% total solids, and is fed to the anaerobic digesters for stabilization. Gravity thickener overflow merges with the primary effluent at the settled sewage effluent pump station wet well, from which it is sent to the BNR activated sludge system.

Sludge Stabilization

Thickened sludge is anaerobically digested in four mesophilic anaerobic digesters operated in parallel. Digesters 1 and 4 are 700,000 gal each (74.5-foot diameter and 18-foot sidewater depth), while Digesters 2 and 3 are 430,000 gal each (65-foot diameter and 15-foot sidewater depth). The digesters are fed proportionally based on their respective volumes.

Digesters 1, 2, and 3 have floating steel covers, while Digester 4 has a skirted gas holding cover to provide biogas storage. Gas is utilized for digester heating, by heating the incoming raw sludge and also heating recirculated digested sludge, to maintain digester temperatures in the mesophilic temperature range. Historical data confirms digester temperatures have been sustained at 95-98 degrees Fahrenheit, at the upper end of the mesophilic range. The two sludge heaters (combination boiler and heat exchanger) provide a total of 4-million British Thermal Units (BTU) of boiler and sludge heat exchanger capacity.

Biosolids Thickening and Dewatering

Digested sludge (biosolids) is thickened on a single 2-meter gravity belt thickener (GBT). This unit used to be operated intermittently, as-needed, at full capacity. However, to stabilize/equalize the sidestream loadings, that can be high in N and P recycled to the plant, operation of the GBT has been changed to continuous (24 hours per day, 7 days per week), and successfully managed during times when the plant is staffed and unattended – the latter via monitoring by a remote camera display. Thickened sludge is targeted at 5-8% solids to maximize storage yet retain feasibility for land application (based on land application equipment limitations). The thickened sludge is pumped to liquid storage tanks and filtrate flows back into the liquid treatment process upstream of the grit tanks. Ferric chloride is added to the GBT filtrate to help control recycle phosphorous, struvite, and odors.



Figure 5 - Gravity Belt Thickener

In lieu of thickening, the digested biosolids can also be dewatered to further improve sludge storage abilities or provide alternative opportunities for land application. Biosolids are dewatered on a single two meter belt filter press. Fresh digested sludge typically dewater better than stored liquid biosolids, typically achieving 20-23% total solids compared to 15-18% total solids for the stored liquid material.

Similar to the GBT, ferric chloride is dosed to the BFP filtrate to control recycle phosphorus, struvite, and odors.

Separate emulsion polymer makedown systems feed the thickening and dewatering equipment. Limited free space exists for tote storage and handling for dewatering polymer. Current practice requires polymer tote storage and handling to be performed in the second story exterior doorway. With the doorway open, this limits use of the belt filter press to periods of warmer weather.

Biosolids Storage

Biosolids are stored primarily as liquid before engaging dewatering. The biosolids storage facilities consist of two 3-million gallon liquid storage tanks. Pumps in the lower level of the connecting building can be used to mix the tanks and additional pumps discharge biosolids to a truck loadout for land application.

Liquid storage provides approximately 150-180 days of storage depending on the applied loading to the treatment plant. Unpredictable weather patterns often cause delays in getting all the biosolids land applied in a timely manner, which results in a need for additional storage. To supplement biosolids storage, the dewatering facility is operated and biosolids are transferred by a dump truck to be stacked and stored in a covered cake storage shed. The cake storage building provides approximately 30 days of biosolids storage.

The limited storage available requires land application of biosolids in the spring and fall. If available, summer land application to alfalfa fields is used to help lessen the burden of fall land application. To expedite the hauling effort, the City has contracted with Synagro until 2020 to provide biosolids hauling and management of the nutrient application. The combined liquid and cake land application program requires over 1800 acres when applied at appropriate nutrient rates for nitrogen. Additional acres would be required for phosphorus based nutrient management. These acres are often small parcels (average size is 17 acres) due to the terrain along the Mississippi River. The resulting interaction with numerous parcels requires significant coordination and agreement between landowners, tenant farmers, and the City's team. The current practice requires over 1100 truckloads in and out of the City for 2 to 3 weeks, twice a year. Annual costs for the land application program averaged \$860,000 in recent years.

Site Considerations - Utilities

The WWTF obtains electricity from Xcel Energy through three power feeds and is invoiced separately for each. The three feeds serve the Main WWTF, the Blower Building, and the UV Building. Power demand is split roughly 48% to the Main WWTF, 46% to the Blower Building, and 6% to the UV Building. The combined power consumption is 5,500,000 kWh per year, at a cost of over \$450,000. The normalized power draw for the flow treated exhibits a rate of 1473 kWh/MGD, which is under the best practice benchmark established by Focus on Energy of 1760 kWh/MGD, but implies there may be efficiency improvements available when compared to the target top performance quartile for facilities under 1,350 kWh/MGD. The normalized power draw for the load treated exhibits a rate of 572 kWh/1000 lb BOD, which far exceeds the target of 900 kWh/1000 lb BOD.

Backup power is provided by four standby diesel generators serving critical systems throughout the facility. The two oldest units serve Plant 1 and Plant 2 and were installed in the 1972 upgrade. Parts availability and reliability is a concern. Additionally, the aeration blowers are not connected to standby power, which severely complicates effluent compliance when power is lost for an extended duration.

Natural Gas is available from Xcel Energy a parent company of the Northern States Power Company of Wisconsin.

Potable water is available from the City of La Crosse.

Data communication throughout the site is available through fiber optic network; however, radio is used to connect with the collection system lift stations. The City noted difficulty obtaining reliable radio signals due to the river valley and bluffs that block direct line of sight from the WWTF to the remote sites.

Site Considerations - Environmental Restrictions

Isle La Plume WWTF was constructed on an island within the Mississippi River. Being close to the discharge point at the Mississippi River is an advantage for the treatment facility, but it also increases potential exposure to flooding. The treatment facility is in the flood plain, but it is not in the flood way. The WWTF has survived several significant flooding events, which prompted the Engineering Department for the City of La Crosse to provide a review of the flood zone identification for the treatment facility property in 2009 as part of previous planning efforts. In the meanwhile, FEMA revised maps of this area on January 6, 2012 to better reflect the observed flood limits. This revised map is included in Appendix A. No critical WWTF areas are vulnerable to a 1% annual flood chance (100-year flood); however, some areas are vulnerable to a 0.2% annual flood chance (500-year flood). The rough contours of the map indicate portions of the primary clarifiers and gravity thickeners would be compromised. However, a site survey could be performed to prove that these tanks are installed at or above the flood level of 642.33 ft.

The Isle La Plume has been noted to be originally an old landfill prior to development as the WWTF. Although the debris has not been observed to create differential settlement, it has been suspected to contribute to elevated mercury levels during periods of high river stage (groundwater). The high groundwater leaks in through the building walls and cause the structural sump pumps to engage, which could be a reason that the effluent mercury is higher than the influent mercury at times. The City is continuing to investigate this issue as part of their Pollutant Minimization Plan (PMP) for mercury.

The WWTF is situated on the west edge of the City and odors are a continual concern to be attentive to the rate payers. Despite this concern, the facility does not currently mitigate odors with treatment. In recent years, the majority of odor complaints have been due to odorous activities taking place at City Brewery.

WPDES Permit

The WWTF is governed by National Pollution Discharge Elimination System (NPDES) Permit WI-0029581-09-0. The current version of this permit came into effect January 1, 2016 and expires December 31, 2020. A copy of the permit is included in Appendix C. Several items in the Permit that are particularly relevant to the facility planning effort are presented below.

Permitted Outfalls

The NPDES Permit regulates one continuous discharge to the Mississippi River and it outlines the requirements for land application of Class B biosolids as liquid or cake products. Discharges are described below.

Design Capacity

The NPDES Permit identifies the treatment facility is designed to treat an average annual flow of 20 MGD and a maximum month BOD of 29,793 lb/d.

Effluent Limits (Outfall 001)

Tables 1 and 2 below are an abbreviated list of the treatment plant effluent limits. The complete effluent limits and monitoring requirements are included in Appendix C. The City was issued a variance to avoid additional treatment for effluent mercury limits.

Table 1 - Effluent Limits

Parameter	Limit	Type
5-day Carbonaceous Biological Oxygen Demand (CBOD ₅)	25 mg/L	Monthly Avg
	40 mg/L	Daily Avg
Total Suspended Solids (TSS)	30 mg/L	Monthly Avg
	45 mg/L	Weekly Avg
Total Phosphorus (TP)	1.0 mg/L	Monthly Avg (Interim)
	0.1 mg/L, (17 lbs/d)	6-Month Average
	0.3 mg/L	Monthly Avg
Fecal Coliform	400 #/100 mL	Geometric Mean
pH	6.0 / 9.0	Daily Min/Max

Table 2 – Ammonia Nitrogen Effluent Limits

Effluent pH (s.u.)	Daily Maximum NH ₃ -N Limit (mg/L)
pH ≤ 7.6	No Limit
7.6 < pH ≤ 7.7	29*
7.7 < pH ≤ 7.8	24*
7.8 < pH ≤ 7.9	20*
7.9 < pH ≤ 8.0	17

* Only apply November through April.

Historical Flows and Loadings

Analysis of historical flow and loads is based on the three year period between January 1, 2015 and December 31, 2017. This is summarized in Table 3. The table includes average day, maximum month, maximum week, and maximum day values for major influent loading parameters. Peak hourly influent flow recorded is included in the table.

Table 3 - Summary of 2015-2017 Influent Flows and Loadings

	Average	Max. Month	Max. Week	Max. Day	Peak Hourly
Flow (MGD)	10.07	11.94	13.15	17.9	32.3
BOD (lb/d)	25,975 (308 mg/L)	29,400	35,200	64,000	
TSS (lb/d)	29,529 (352 mg/L)	48,900	60,900	100,00	
TKN* (lb/d)	3,058 (34 mg/L)	5,000	n/a	n/a	
Ammonia* (lb/d)	1,714 (19 mg/L)	2,500	n/a	n/a	
TP (lb/d)	548 (6.6 mg/L)	675	800	1,500	

*Ammonia and Total Kjeldahl Nitrogen (TKN) data is based on limited data taken only once per month.

Figure 6 illustrates influent wastewater flow and rainfall during this period. Comparing wastewater flow rate with rainfall is useful for identifying the effects of inflow and infiltration (I&I) in the collection system.

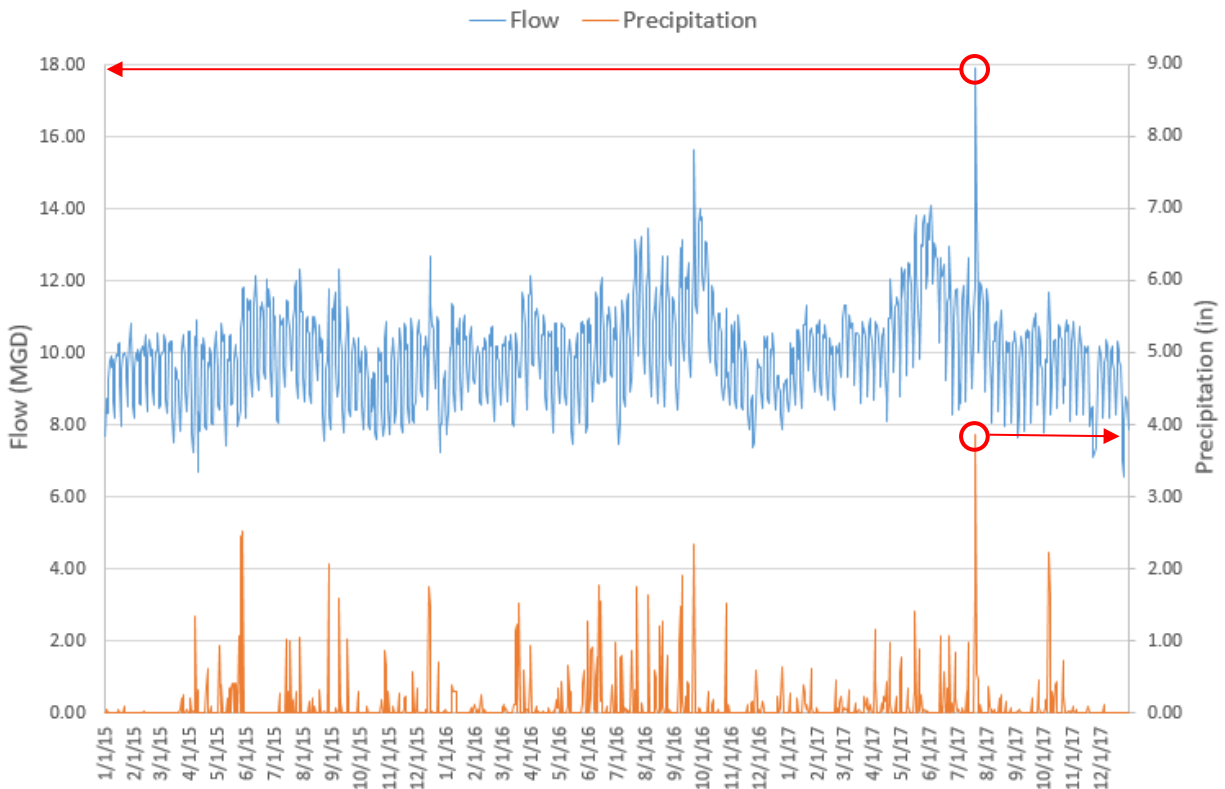


Figure 6 - Influent Flows and Rainfall

I&I is essentially clean water that enters the collection system as a result of precipitation or elevated ground water levels. For the case of La Crosse, high groundwater is directly influenced by river level. Inflow is considered to represent rainfall contribution from sources such as manhole covers, roof drains, foundation drains, or cross connections with storm sewers. Infiltration is groundwater that enters the collection system through defective pipes, pipe joints, and manholes.

Clean water entering the treatment facility increases operational costs through increased demands on equipment and reduced treatment efficiency. It also reduces the effective capacity of the facility. Infiltration is defined as being excessive when the weekly average flow exceeds 120 gallons per capita per day (gpcd) during periods with seasonally high groundwater. Inflow is excessive if wastewater flow during storm events exceeds 275 gpcd. The City is aware of areas in the collection system that are exposed to inflow from surcharged storm water infrastructure or high groundwater. Recent construction projects in recent years have addressed several of these major I&I issues; however, peak flow preparedness is still required.

The past few years of historical data in Figure 3 supports the fact that I&I directly correlates with high flows at the WWTF. Although this dataset includes a notable 4" rain, a larger storm of 16" was documented in 2007. This storm produced unprecedented flooding and created higher peak instantaneous flows at the WWTF than the July 2017 event. Table 4 summarizes the flows exhibited by these two high flow events. The WWTF was designed to accommodate peak flows of 44 mgd, and readily conveyed the recent peak flow of 42.5 MGD with no issues. Although the City has reduced I&I since the 2007 event, this peak flow is recommended to be retained for future capacity requirements as it is more conservative than the 2017 data. The Utility should continue efforts to reduce I&I as opportunities arise.

Table 4 - Peak Hourly Flow

	Average Daily Flow (MGD)	Max Peak Hourly Flow (MGD)
2007	8.8	42.5
2017	10.2	32.3

Recent Treatment Performance

The wastewater treatment facility has exhibited excellent performance, in both effluent quality (as discussed further below) and energy efficiency operation. The staff have optimized the current facilities to consistently provide stable biological treatment, which has yielded a perfect Compliance Maintenance Annual Report (CMAR) effluent score for several consecutive years.

The consistent, high-quality effluent is illustrated in Figure 7 through Figure 10 for cBOD, TSS, ammonia, and TP, respectively. In particular, Figure 9 demonstrates how the facility achieves full nitrification for the majority of the year, except for late winter when flows are typically coldest. The City has approached the maximum day ammonia limits, but the limit has not been exceeded. Improvements to the secondary treatment process may achieve a more consistent effluent ammonia concentration.

In agreement with the City's Optimization Evaluation Report (OER) developed in response towards potential compliance with future TP limits, Figure 10 confirms the fact that the facility has made positive strides towards optimization. It is worth noting that maximum monthly effluent TP values reached 0.81 mg/L TP in 2014, and that recent months now average 0.40 mg/L TP. However, compliance with the future 0.1 mg/L TP limit is not possible without filtration improvements.

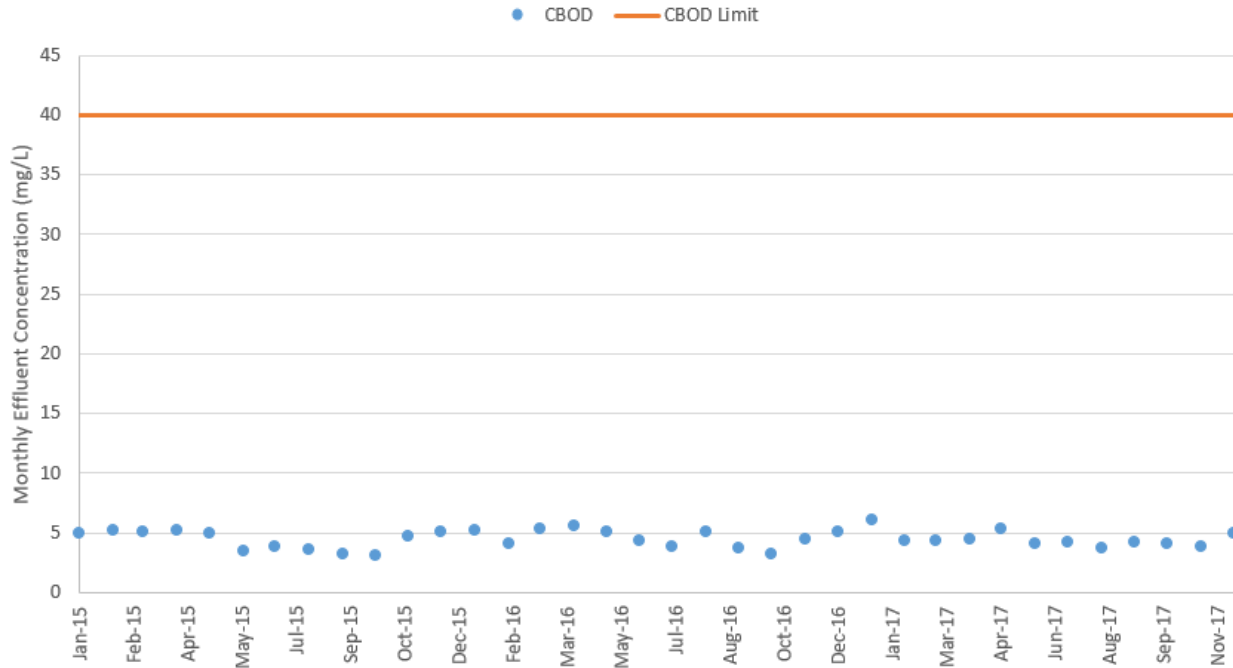


Figure 7 - Effluent CBOD₅ Concentration

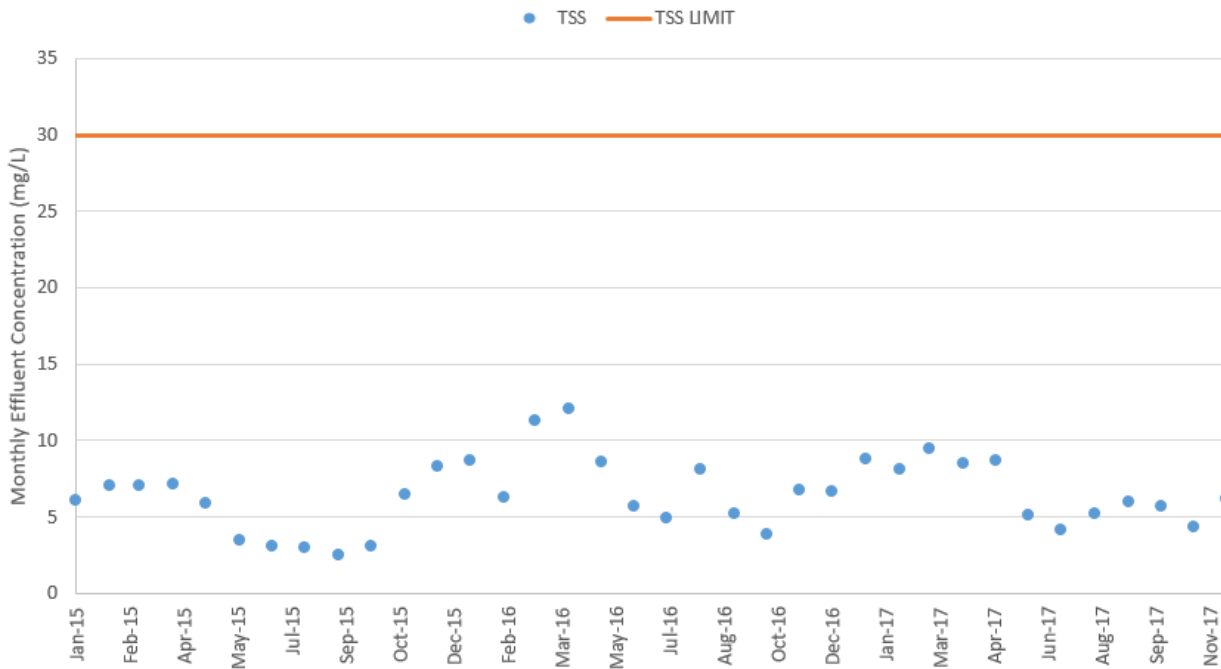


Figure 8 - Effluent TSS Concentration

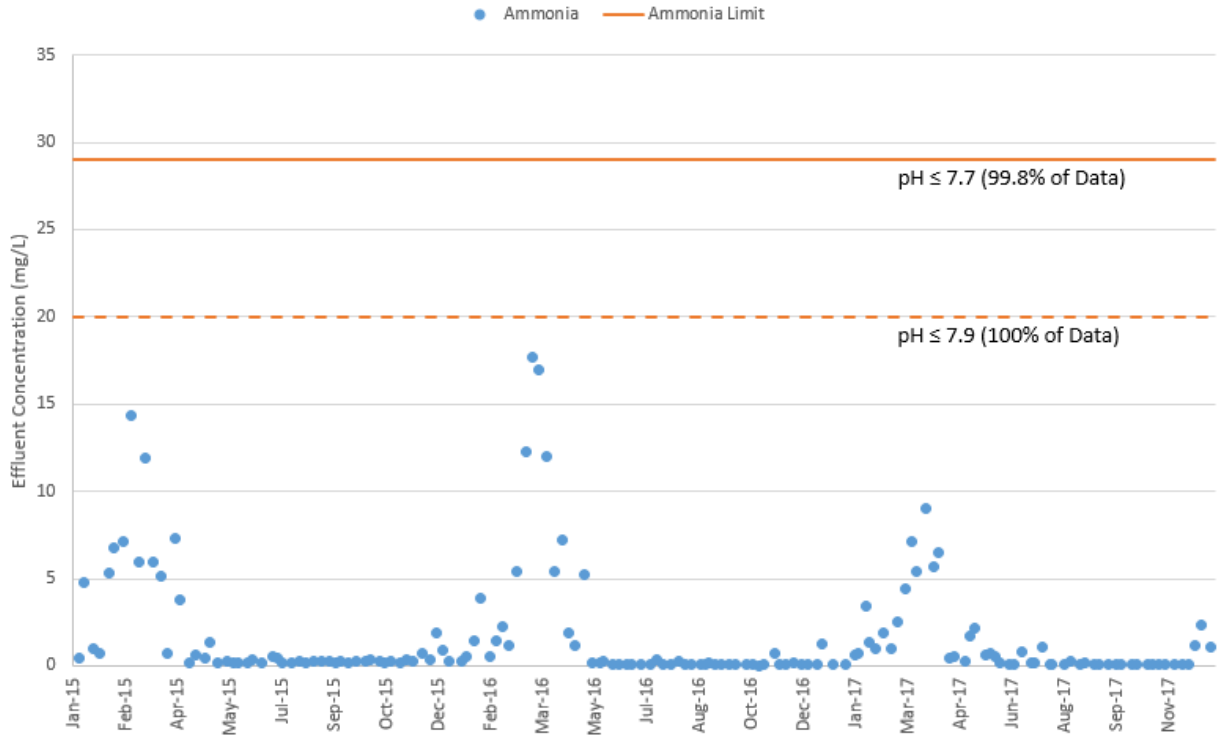


Figure 9 - Effluent Ammonia Concentration

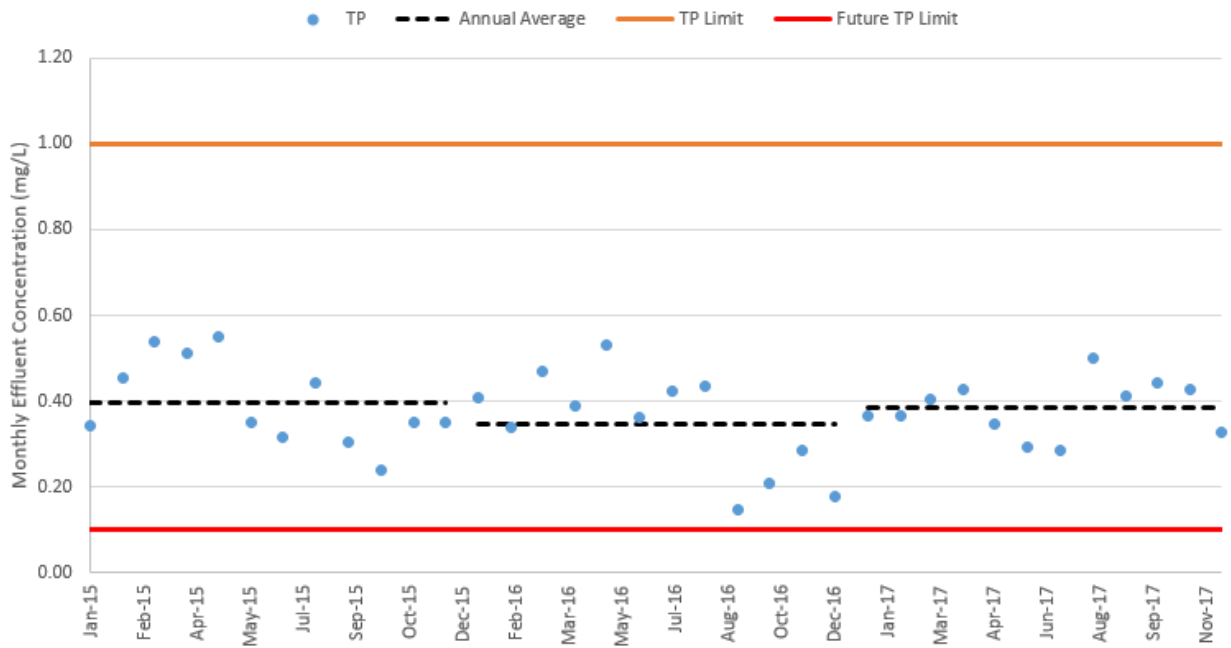


Figure 10 - Effluent TP Concentration

Sludge generated during the treatment of wastewater must also be stabilized prior to reuse as fertilizer in the City’s land application program. The historical sludge production is summarized in Table 5 below.

Table 5 – Historical Average Sludge Production

WAS				PSD*				Total Sludge to Digestion			
Flow	Conc.	Conc.	Load	Flow	Conc.	Conc.	Load	Flow	Conc.	Conc.	Load
MGD	% TS	% VS	lb VS/d	gpd	% TS	% VS	lb VS/d	MGD	% TS	% VS	lb VS/d
0.356	0.43	79%	10,100	n/a	n/a	n/a	19,550	0.158	3.0	75%	29,650

* Primary sludge (PSD) data was unavailable during the data period

The combined sludge yield is within industry standard ranges for the pounds of waste received. The proportion of primary solids received appear disproportionately higher in pounds and disproportionately lower in volatile content than typical municipal sludge. Supplemental sampling of the primary sludge is recommended to confirm the validity of the sludge data. The significant portion of industrial wastes are likely influencing the primary sludge data.

Based on the sludge flows to digestion, the average digester hydraulic retention time (HRT) is 14 days. This is below the NR110 recommended 15 day minimum sustained condition. Based on the sludge loading applied, the average organic loading in the digesters is 98 lb/1,000 cubic feet (cf). This value exceeds the NR110 recommended 80 lb/1,000 cf, but within the industry standard maximum of 120 lb/1,000 cf. These loading criteria support the fact that WWTF capacity is limited based on the solids handling system. Combining these high loadings with limited mixing in the digesters, substantial short circuiting and reduced performance would be anticipated. However, sludge monitoring data suggests the digesters are actually performing quite well. This is suspected to be due to highly degradable particulate wastes received from industry.

The sludge applied to digestion enters at 75% volatile content, and exits at 62% volatile content. Based on the mass balance of material, this results in 50% volatile solids reduction (VSR); which provides acceptable solids stabilization at current conditions. Biogas is metered at the points of utilization (each boiler and the waste gas flare), with an average biogas production rate of 156,500 cf/d. The specific biogas yield ranges from 14-20 cf/lb VSR, which is above average from the industry standard range of 12-16 cf/lb VSR.

Facility Issues & Observations

A meeting between Donohue engineers and City officials occurred on August 15, 2018 to discuss the existing conditions, operations and maintenance, and future concerns. The full meeting notes are detailed in Appendix D, while the key notes on the existing facility include the following:

- Site
 - The only odor complaints are typically due to City Brewery's facility.
- Administration Building
 - Has been repurposed many times since 1936.
 - HVAC is aging and inefficient.
- Preliminary Treatment
 - No equalization of hauled waste receiving or convenient ability to direct to anaerobic digestion.
 - No influent flowmeter (currently use primary effluent or final effluent).
 - Recent 4" rain resulted in a 32 MGD peak flow; however, higher flows were observed in 2007.
 - Grit deposits upstream of the comminutors and overwhelms the downstream systems every time the fine screen channel is taken offline.
 - Stringy debris passes through the existing ¼-inch step screen.
- Primary Settling
 - City uses their trucks to transfer approximately 4,000 gallons per week of brewery waste (retentate backwash, 350,000 mg/L COD) to supplement primary effluent BOD on weekends, holidays, and during facility shutdowns. The waste is stored at the plant in two 3,000 gallon polyethylene tanks.
- Aeration Basins
 - Medium voltage blowers were replaced in 2012 with 480V high speed turbo blowers. Typically operate with D.O.s in range of 3 mg/L - unable to operate at lower DOs due to aeration control system & blower constraints. Currently run 2 blowers to limit starts/stops.
 - Blowers are not on standby power
 - Single, line-size aeration valve cannot throttle system to maximize system efficiency. Valve closure below 19% open may create concern for mixing limited conditions.



Figure 11 - Existing Septage Receiving



Figure 12 - Airflow Control Valve

- Secondary Settling
 - Concern regarding algae control in effluent weirs/launders.
 - Potential mixed liquor flow distribution imbalance into the secondary clarifiers.
 - Concern for settling without flocculating energy dissipating inlet

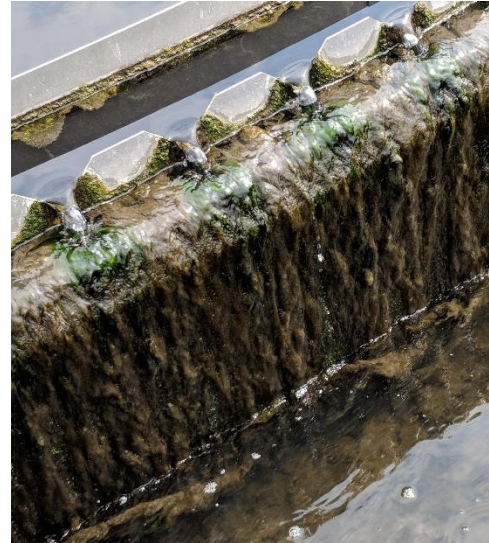


Figure 13 - Final Clarifier Algae

- UV
 - Bulb/sleeve cleaning frequency has decreased since City Brewery switched from using Ferric Chloride for odor control (now use Hydrogen Peroxide).
- Solids Handling
 - The digesters have been rehabilitated one per year for the last several years with Digester 1 planned to be completed in the coming year.
 - Solids handling is a main concern of the facility as it limits capacity, noted by staff and confirmed by the 2016 re-rate study.
 - Evident digester capacity improvement is to increase sludge concentration into the digesters; however, mixing systems will be required as sludge viscosity changes. Other digester/sludge system capacity improvements need to be identified.
 - Currently no digester mixing (just recirculation and transfer). The group discussed the options for digester mixing. The City indicated that recent digester cover rehabilitations were performed without consideration for future adaptation to linear motion mixing due to the cost of cover modifications needed.
 - The two larger digesters have taller sidewall elevations than the older digesters.



Figure 14 - Anaerobic Digester Complex

- Biogas
 - Substantial excess biogas is flared. Potential exists for cogeneration facilities to burn biogas to produce electricity. The City is OK with adding this extra equipment if done properly and with a maintenance contract to limit/minimize any added O&M burden to the existing (limited) staff.
 - A biogas line has been routed to the admin building for potential use in the house boilers
 - Biogas storage is currently limited, and the City's preference would be for a low-pressure slab on grade biogas storage membrane because this decouples the gas storage from digester maintenance.
- Sludge Storage
 - Capacity requires semi annual sludge hauling. Wet seasons increase reliance on already tight situations for storage.

- Capacity is limited to 30 days of storage at historical sludge production rates.
- City has contracted with Synagro to ensure liquid and cake hauling requirements for the next two years.
- BFP operation is not efficient with equipment separated from the cake storage location.
- Use of a solar (greenhouse) sludge dryer was noted to be a high-potential alternative to increase the capacity of the existing cake storage building, while improving land application and public acceptance.



Figure 15 - Cake Biosolids Handling

Appendix A Flood Hazard Area Identification

Appendix B Existing Unit Processes

Appendix C WPDES Permit

Appendix D 8/15/2018 Facilities Plan Meeting Notes

Technical Memorandum 3
Future Conditions
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
Eric Lynne – Donohue & Associates
Ben Stephens – Donohue & Associates

Purpose

Technical Memorandum No. 3 (TM 3) presents the development of projected flows and loadings for the planning period of 2020 through 2040 for the for the City of La Crosse, Wisconsin, Isle La Plume Wastewater Treatment Facility (WWTF). This memorandum summarizes projected influent flow and loading information based on several parameters, inclusive of recent discussions with significant industrial users and municipal partners. Following the flow and loading development, a summary of future regulatory conditions is provided to identify system needs with respect to current treatment abilities.

Background

The Wastewater Utility for the City of La Crosse operates a regional wastewater treatment facility serving an extended sewer service area in the vicinity of La Crosse. The sewer service area includes the adjacent entities of the City of Onalaska, the Town of Campbell, Sanitary Districts 1 and 2 in the Town of Shelby, and the City of La Crescent, Minnesota. Service to entities outside of the City of La Crosse is provided based on negotiated contracts.

As developed in TM2, a summary of flows and loadings from the sewer service area (SSA) collection system is re-presented in Table 1. These values are significant because they will be used as the basis from which to project future values in this TM.

Table 1 - Summary of 2015-2017 Combined Influent Flows and Loadings

	Average	Max. Month	Max. Week	Max. Day	Peak Hourly
Flow (MGD)	10.07	11.94	13.15	17.9	32.3
BOD (lb/d)	25,975 (308 mg/L)	29,400	35,200	64,000	
TSS (lb/d)	29,529 (352 mg/L)	48,900	60,900	100,00	
TKN* (lb/d)	3,058 (34 mg/L)	5,000	n/a	n/a	
Ammonia* (lb/d)	1,714 (19 mg/L)	2,500	n/a	n/a	
TP (lb/d)	548 (6.6 mg/L)	675	800	1,500	

*Ammonia and Total Kjeldahl Nitrogen (TKN) data is based on limited data taken only once per month.

The combined influent wastewater received at the facility is a combination of two primary wastewater categories.

- 1) **Municipal Wastewater:** This portion is comprised of wastewater generated by residential, commercial, public, and light industrial users located within the sewer service area (SSA) of the Isle La Plume WWTF. The following entities contribute towards this municipal waste component:
 - a. City of La Crosse
 - b. City of Onalaska
 - c. City of La Crescent
 - d. Town of Campbell
 - e. Town of Shelby
 - f. Hauled In Wastewater

- 2) **Industrial Wastewater:** Industrial users discharging loadings that have potential to impact process treatment are considered significant enough to be significant industrial users (SIUs). Often times, SIUs are defined as any industrial user that contributes flows and/or loads to the treatment facility that requires treatment capacity above normal municipal waste generation rates. The main SIUs are as follows:
 - a. City Brewery
 - b. Kwik Trip Dairy and Bakery
 - c. Great Lakes Cheese
 - d. Trane

The following subsections detail each of these categories and develop future projections based on best available records and information from the representative sources.

Design Flows and Loadings

The design flows and loadings, as described in the following subsections, is intended to estimate Year 2040 conditions and have been developed by adding projected flow and loading increases to the historical dataset presented in Table 1.

Historical Flows and Loads

Future projections can be derived from historical trends for influent flow and loading, and extrapolated higher for future growth. These types of projections are typically best suited for stagnant or predictable growth scenarios. Several factors invalidate this type of projection for the City of La Crosse, as it over-projects the required capacity. The La Crosse SSA exhibits the following features that must be considered for future conditions:

- Identifying no-growth SSA regions
- Credit growth for added SSA communities
- Consideration for newly sewered homes identified in the SSA
- Short planning horizon for SIUs
- Pretreatment system changes at SIUs
- Peak flows fluctuate based on river level and storm intensity
- Minimization of clearwater decreases per capita flows

A more appropriate method divides the historical data into precise increments and develops projections for each category (municipal and industrial) and merges the projections to obtain a total future flow and load.

Municipal Wastewater – Design Flows and Loadings

Future Sewer Service Area Population

Growth of the Sewer Service Area (SSA) for the Isle La Plume WWTF has been developed based on the City of La Crosse SSA Plan and additions that would be contributed by the adjacent entities served by the WWTF. The fraction of raw wastewater flow contributed by residential, commercial, public and light industrial sources are projected based on per capita growth rates of the SSA.

Past, current and future projected sewer service populations the Isle La Plume WWTF are presented in Table 2 and Figure 1. Service population estimates are based off of the *La Crosse Sewer Service Area Water Quality Management Plan 2013 - 2035*, Department of Administration (DOA) sources, but have been modified to reflect the projections developed during Municipal Partner meetings.

Steady growth is projected in Onalaska and Shelby. Onalaska may be limited in area; however, plans for future densification indicate potential for long range planning population to reach 25,000. A 5% increase to Onalaska's population was added to the contingency to reflect this trend. Major step-wise increases in flow from Shelby are expected as cost effective connections to the City of La Crosse conveyance system are identified.

La Crescent populations from the DOA exhibit declining populations; however, these were dampened with increased population associated with specific growth areas presented in a meeting with City officials.

Contingency populations were assigned to represent added flow from existing homes in unsewered portions of the Towns of Hamilton and Medary. Only 25% of the Town of Hamilton population was included to represent the actual portion covered by the existing sewer service area plan. The Town of Medary is 100% covered by the sewer service area; however, no municipal partnership contract is in place to service these homes. Near term capacity use of

contingency population expansion includes the capacity to add the equivalent of 600 homes by 2025 in Shelby.

Table 2 - 2040 Estimated SSA Population

	2010 Census	2015 Estimate	2020 Projection	2025 Projection	2030 Projection	2035 Projection	2040 Projection
T Campbell	4,314	4,385	4,395	4,405	4,400	4,350	4,315
T Onalaska	5,623	5,810	5,990	6,150	6,305	6,390	6,485
T Shelby	4,715	4,760	4,945	5,075	5,190	5,260	5,340
C La Crosse	51,320	52,200	52,550	52,750	52,700	52,300	51,850
C Onalaska	17,736	18,740	19,860	20,950	21,950	22,770	23,570
La Crescent	5,139	5,060	5,022	4,972	4,911	4,845	4,776
Contingency	-	-	3,202	3,318	3,426	3,497	3,575
Total Municipal Population	88,847	90,955	95,964	97,619	98,882	99,413	99,911

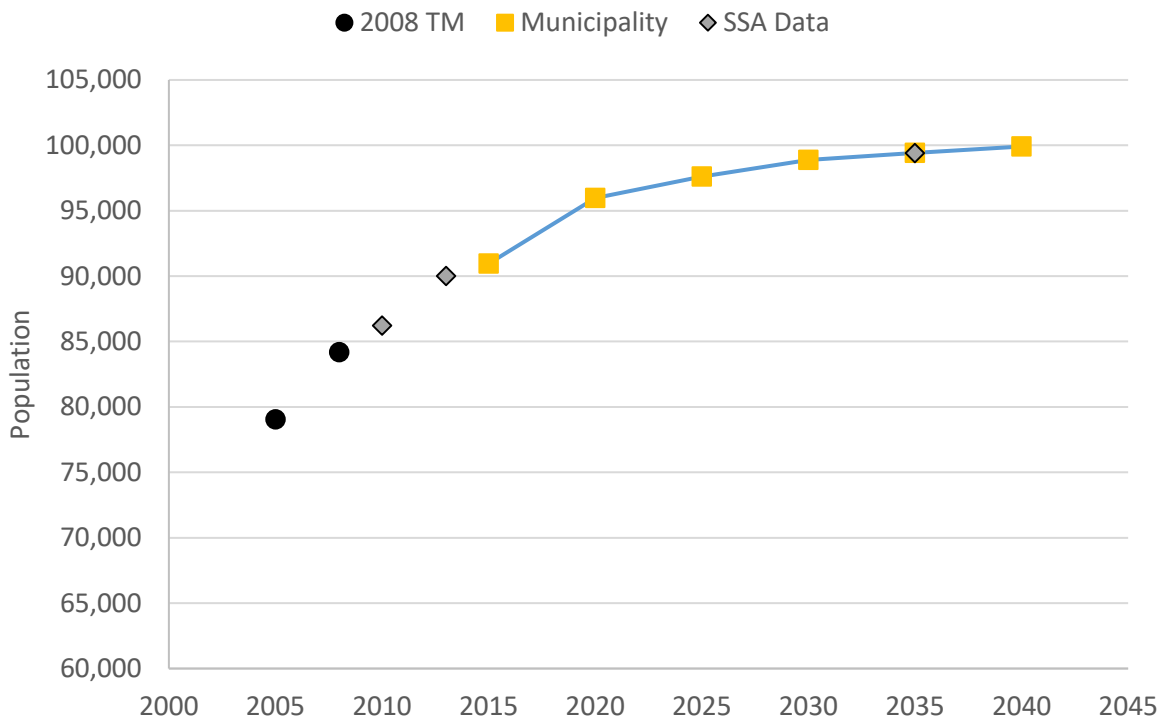


Figure 1 - 2040 Estimated SSA Population

Future Municipal Flows and Loads

Future residential flows were estimated using historical per capita production rates after excluding significant industrial users. The calculated per capita residential flow and loading rates

are summarized below. These values fall within industry standard municipal waste production ranges.

Flow	88	gpcd
CBOD5	0.13	ppcd
TSS	0.23	ppcd
TKN	0.025	ppcd
TP	0.004	ppcd

These values are coupled with SSA population growth estimates to generate municipal flow and load estimates in Table 3.

Table 3 – Summary of Municipal Flows and Loadings

Year	Population	Flow (MGD)	BOD (ppd)	TSS (ppd)	TKN (ppd)	TP (ppd)
2015	90,955	8.03	11,924	21,304	2,242	402
2030	98,882	8.73	12,963	23,161	2,437	437
2040	99,911	8.82	13,098	23,402	2,462	441

Hauled In Wastewater

Municipal wastes typically enter through the collection system, however, for areas not served by sewers, septage haulers extract the wastes and deliver it by tanker truck. These wastes are monitored individually, but are accounted for as part of the total raw wastewater sample and flow records.

Selective waste loads from grease traps are also accepted when staff is present. Hauled waste is not metered, but is billed to the hauler based on volume. 2017 totals are summarized in Table 4 below. Due to inconveniences in land application of these hauled wastes more haulers are requesting receipt at the WWTF. 2018 totals in progress indicate hauler loads are projected to surpass 2017 totals by 15%. The future growth of hauler loads is not anticipated to continue a 15% increase annually, but is an ever present feature that should be accommodated.

Table 4 - Summary of 2017 Waste Accepted from Haulers

Source	Number of Loads	Total Gallons
Holding & Septic Tanks	980	2,899,070
Grease Traps	276	547,245
Others	615	1,676,120

Future Industrial Wastewater Flows and Loadings

Although La Crosse has been contacted by industries that would like to build production facilities in the SSA, additional capacity for an undefined industry would add significant capital cost to this project, which the existing rate payers would have to bear. Therefore, the City has elected providing no additional capacity for future undefined industries. However, in an effort to support existing rate

payers and community growth, meetings were held to discuss the facilities planning project and identify industrial projections.

Current industrial flows and loadings are summarized in Table 5 below.

Table 5 – Existing Industrial Flows and Loadings

Industry	Flow (MGD)	BOD (ppd)	TSS (ppd)	TP (ppd)	Comments
Aramark	0.19	346.4	67.9	5.7	Growth since 2008
Brennan Marine	0.00	0.3	0.4	0.2	No significant change
Chart	0.07	81.3	35.7	1.9	Growth since 2008
City Brewing	1.33	8,573.4	6,683.6	85.1	Significant growth since 2008
Crown	0.06	61.2	17.9	0.4	No significant change
Great Lakes Cheese	0.15	2,019.1	534.1	21.6	Significant growth since 2008
Kwik Trip	0.15	2488.9	875.6	30.2	Significant growth since 2008
Metallics	0.01	0.0		0.0	No significant change
S&S Cycle	0.00	2.2	4.5	0.0	No significant change
Trane Co	0.01	24.3	2.4	0.1	Decreased discharge since 2008
Wis-Pak	0.07	454.1	3.0	1.0	Growth since 2008

Industrial flow and loading projections were requested from a number of major local industries to assess the future industrial load. Responses from four of the industries: City Brewery, Great Lakes Cheese, Kwik Trip, and Trane were documented and are summarized with Table 5. Industries that did not have an updated projection, the existing conditions were carried forward for the projected condition. Although updated projections from all industries was not obtained, the industries projections obtained represent over 86 percent of the industrial contribution.

The industrial load projections generated through this method are reported in Table 6. No industries are expected to have a major increase in TKN loadings over the planning period.

Table 6 – Projected 2040 Industrial Flows and Loadings

Industry	Flow (MGD)	BOD (ppd)	TSS (ppd)	TP (ppd)	Comments
Aramark	0.19	346.4	67.9	5.7	
Brennan Marine	0.00	0.3	0.4	0.2	
Chart	0.07	81.3	35.7	1.9	
City Brewing	2.10	5,538.5*	9,230.8	104.0	Values shown are average day. City Brewery provided revised projections of 12,000 lb/d COD and TSS at maximum month, resultant reductions are anticipated with a plan to optimize pretreatment equalization tank and anaerobic reactor.
Crown	0.06	61.2	17.9	0.4	
Great Lakes Cheese	0.15	202	53.4	2.2	Provided projections, new pretreatment DAF system planned to be operational 2019
Kwik Trip	0.33	4,788.0	410.0	25.0	Provided projections. No plans for pretreatment. Kitchens data growing but undefined loading.
Metallics	0.01	0.0		0.0	
S&S Cycle	0.00	2.2	4.5	0.0	
Trane Co	0.01	24.3	2.4	0.1	Continued reductions to TP discharge.
Wis-Pak	0.07	454.1	3.0	1.0	

*COD:BOD ratio of 1.67 used to obtain BOD loadings

The projected industrial flow and load changes are summarized below in Table 7. Note that City Brewery and Great Lakes Cheese BOD loadings decrease with improved pretreatment methods.

Table 7 – Summary of Industrial Flows and Loadings

Year	Flow (MGD)	BOD (ppd)	TSS (ppd)	TP (ppd)
Current	2.04	14,051	8,225	146
2040	2.99	11,498	9,826	140

Contracted Entities Analysis

The City has several contracts with industries within the City of La Crosse and a few regional municipality partners to provide wastewater conveyance and treatment.

Figure 2 provides a summary of each contract and depicts their current and future utilization rate with respect to maximum month flow and loading. The grey shaded bar represents the contracted value and the red shaded bar illustrates the actual (2017) contributions. Future (2040) sewer contributions are represented by a red dashed line. For projections that exceed the grey contracted amounts, the City will need to discuss contractual modifications to avoid violations and/or surcharges.

It is important to note, that the various contracts do not have similar language for management of the entities' flows, loads, and peaking factors. To compare the contracted data, historical raw wastewater loading assumptions were used to normalize the dataset. It is highly recommended that the City develop a standard contract to use upon reissuance of these contracts to provide a basis for common understanding the expected flows and loadings for average and peak conditions.

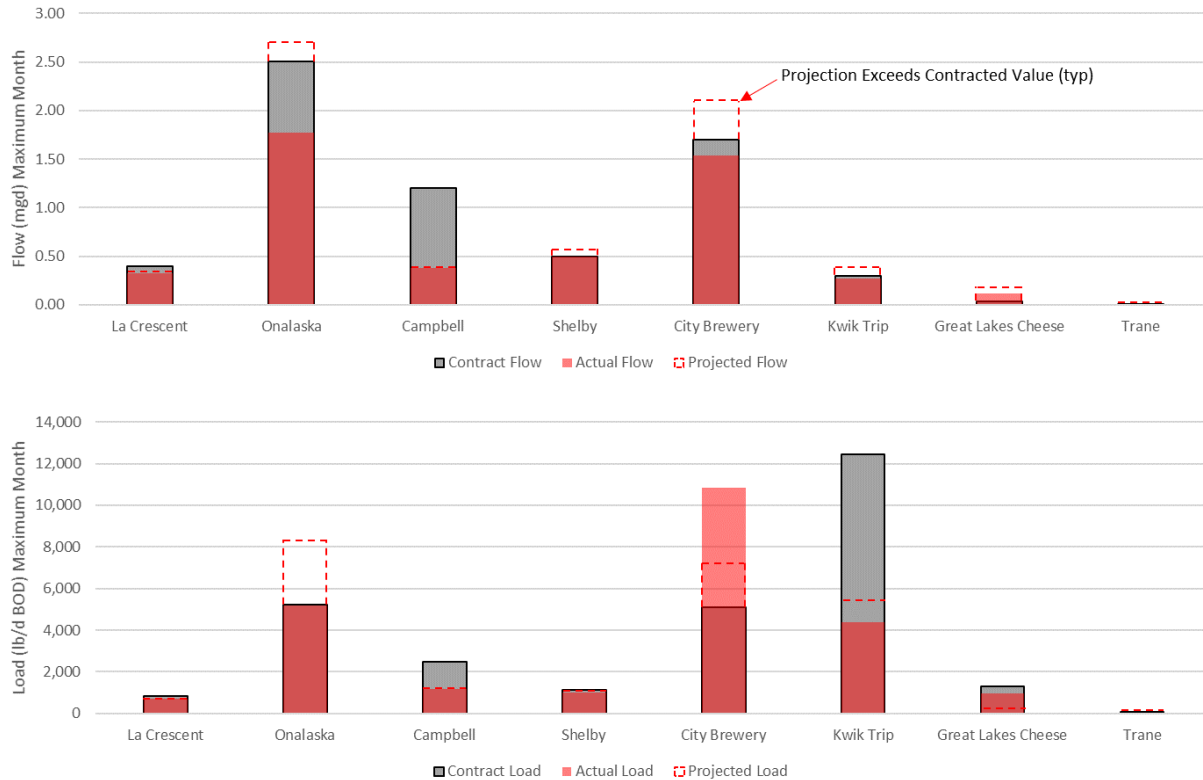


Figure 2 - City of La Crosse Contracts – Individual Basis

To avoid surcharge situations, it is not uncommon for wastewater facilities to have contracts that exceed the actual expected flows and loads, so long as the treatment performance is not impacted. Caution should be used when allocating contracts, as the cumulative contracted flow can reach or exceed the total treatment facility abilities.

Figure 3 assembles these individual contracts, and other non-contracted treatment needs of the facility to better comprehend the cumulative effect of these contracts. Note, that the City of La Crosse is not a contracted entity. Future stakeholder projections (not current contracts) were used to establish this summary. Projected values (shaded areas) exhibits adequate WWTF capacity exists with respect to flow, but show a possible over-capacity scenario for loading. System needs for capacity improvements will be discussed further in TM4.

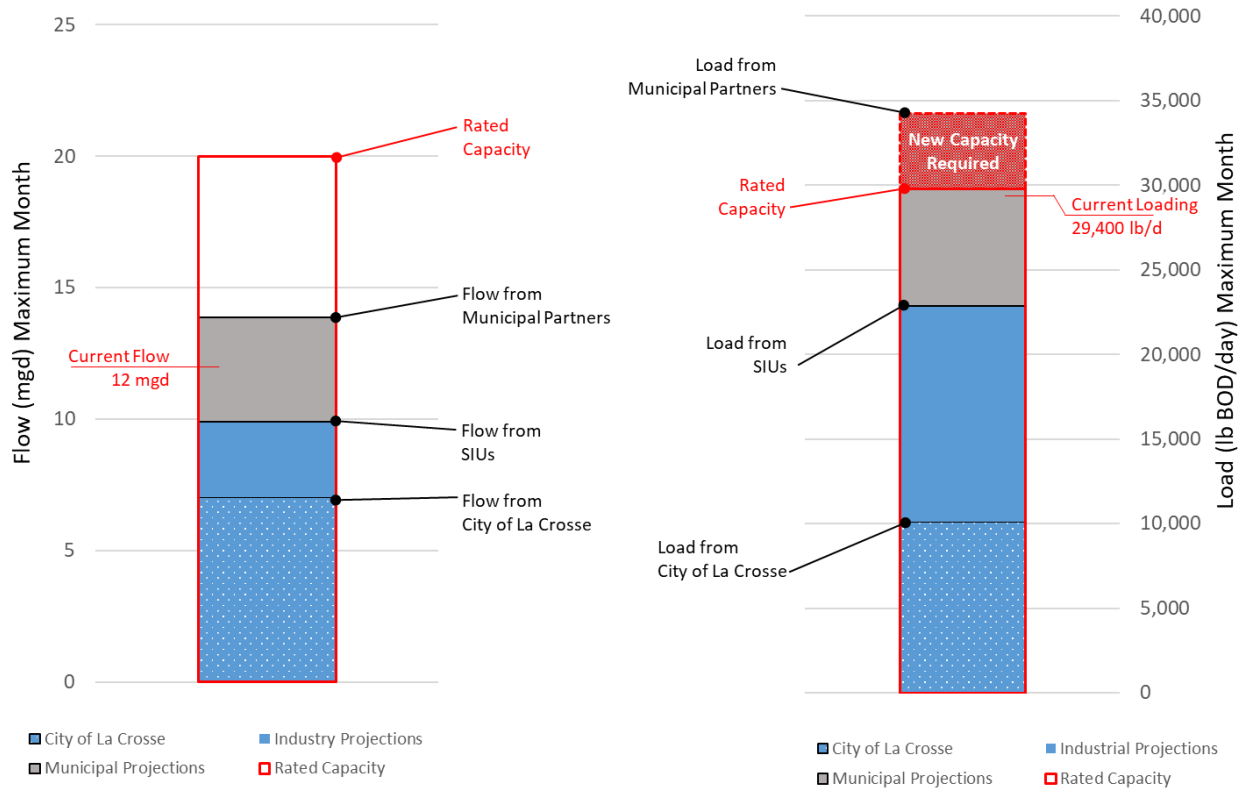


Figure 3 – City of La Crosse Contracts – Cumulative Basis

Infiltration and Inflow Analysis

The Wastewater Utility has addressed removal of inflow and infiltration sources from the sanitary sewer as projects and budgets have allowed. Clear water entering the sanitary sewer system is normal in any collection system, particularly in systems that have been in service for over 60 years. The wastewater utility has done a good job of removing clean water sources and should continue to as projects and budgets allow.

Peak flows for the WWTP are more heavily biased towards inflow related clearwater, which results in a quick rise and fall peaking factor. The highest event documented in 2017 was 32.3 mgd; which exceeds the EPA criteria of 275 gpcd, which adequately identifies the system as inflow deficient. The average dry weather flow of 9.9 mgd, reveals the infiltration criteria suggests that there is no initial concern with infiltration.

The peak hourly factor (excluding industrial data) is 4.0, which is applied to the municipal portion of the flow projections. Applied to the 2040 municipal flows, the respective peak flow is 35.5 mgd. After projecting the municipal peaking factor, the industrial projection (2.99 mgd) is added as baseline flow, for a total of 38.5 mgd. The existing WWTF peak capacity is capable of 44 mgd, with recent observations at over 42.5 mgd without causing basement backups. To retain the ability to treat previously observed storms, a minimum of 42.5 mgd peak hour capacity is recommended. Upgrades beyond this capacity requires significant investment in new tankage and equipment. The City should continue to invest in disconnecting the existing sewer drains from stormwater facilities.

Design Wastewater Flows and Loadings

Design wastewater flows and loadings are estimated by adding together the future municipal load and future industrial load. To reduce the occurrence of being given negative CMAR scores, a 10% buffer capacity has been added to the average flows and loadings, included in Table 8.

Table 8 - 2040 Design Flow and Loading Summary

	Average	Max. Month	Max. Week	Max. Day	Peak Hourly
Flow (MGD)	12.99	15.80	17.70	28.80	42.5
BOD (lb/d)	26,500	32,800	39,000	80,000	
TSS (lb/d)	44,000	56,700	70,000	126,000	
TP (lb/d)	770	800	950	1,900	

A cursory overview of these projections notes that the TSS and TP loads are estimated to increase dramatically by 2020 due to industrial load and then fall into a slower steady growth to 2030, while flow is expected to increase slowly but steadily and BOD may actually drop slightly due to industrial pretreatment systems starting up at Great Lakes Cheese.

Future Regulatory Concerns

While the facility has remained in compliance with current discharge limits, the existing permit includes notable changes that may require changes to the WWTF. The most significant of these changes is the effluent total phosphorus (TP) restriction, decreasing the limit from the current 1.0 mg/L TP to 0.1 mg /L TP. The existing facility has implemented substantial operational adjustments to optimize for phosphorus; however, the effluent quality has yet to attain compliance. Therefore, additional treatment systems, such as filtration, must be constructed and operational prior to December 31, 2024.

The WWTF's current discharge permit includes a compliance schedule to reduce total phosphorus (TP) discharges for both protection of local water quality and the downstream Mississippi River. Effluent phosphorus is limited to 0.1 mg/L TP as a seasonal 6-month average. Based on the facility design flow of 20 mgd, a phosphorous loading of 17 lbs/d (also as a seasonal 6-month average) serves to limit the maximum loading applied to the river. A maximum month limit of 0.3 mg/L TP is allowable to account for variability in effluent quality.

Phosphorus regulatory compliance strategies were reviewed in 2016 by the project team as part of the phosphorus optimization and feasibility studies. Consensus towards traditional WWTF filtration compliance was selected. Thus, for the purposes of developing alternatives and end-in-mind changes to the facility, effluent phosphorus compliance is retained as a deficiency that impacts several unit processes.

To understand the relative importance of other regulatory parameters potentially changing in the planning period, the project team conducted an interview with the WWTF's legal advisor, Stafford Rosenbaum LLP. Highlights from the discussion are summarized below. Unit processes are identified herein have also been identified in each of the subsequent unit process discussion sections as regulatory deficiencies.

Effluent Discharge Regulatory Issues

Nitrogen:

The current ammonia limit reflects acute toxicity and is related to pH. This limit has not posed a problem for compliance and can be addressed with minor operational adjustments. However, the WDNR has indicated potential for weekly or monthly ammonia limits may be necessary during the next permit reissuance. Depending on the extent of these limits, seasonal ammonia excursions may not be permissible.

The current permit also includes monitoring requirements for total nitrogen (TN). These limits are in response to the EPA's 2008 Gulf of Mexico Hypoxia Action Plan. In the WDNR's Nutrient Reduction Strategy, a goal of 45% TN reductions was established, primarily focused on non-point source reductions. The most recent progress report indicates that reductions to TN are anticipated by way of reducing runoff to comply with the local phosphorus criteria. As observed for phosphorus, new limits typically are developed after monitoring data is obtained. However, the focus on point source dischargers is anticipated to be lessened for nitrogen. Since the DNR does not have a mechanism in place to control non-point sources, total nitrogen regulations may still be applied to point sources, but with greater non-traditional compliance methods as was offered for phosphorus compliance. For example, the first few years will could contain optimization steps, interim limits, and eventual development of a statewide variance program to that re-focuses efforts on non-point sources. Compliance with a final limit is not expected sooner than YR 2028.

To account for future regulations imposed by the state or the watershed, facilities planning should consider alternatives to achieve effluent total nitrogen in the 8 mg/L and/or 3 mg/L range.

Mercury:

The current permit includes a mercury variance that enables discharge of a limit higher than the criteria. Historical monitoring data showed exceedances of the 1.3 ng/L mercury daily maximum, and a 4.0 ng/L variance was authorized. The variance heavily supports the continuation of an exceeded value, so long as management practices are continued and show progress towards compliance. Improved understanding of high effluent mercury values will be a key component in the next variance renewal. Threat of discontinuing the variance has not been discussed and is not anticipated in the planning period.

Microconstituents:

Microconstituents include pharmaceuticals, personal care products (PCPs), endocrine disrupting compounds (EDCs), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and other compounds not specifically regulated in wastewater. These constituents represent a multitude of compounds, of which some may pose a threat to aquatic life at elevated concentrations. The scientific research behind these effects are still being developed, therefore no regulations on the discharge of these compounds have been established.

Although source reduction of these compounds may help reduce the influent loading, many of the compounds are still found in urine. Current and ongoing studies have documented the fate of these compounds through a WWTP to be highly variable and compound specific. A key observation has been that longer solids retention time (SRT) activated sludge systems appear to do a better job of treating most of the studied pollutants.

Final regulation on these compounds is uncertain, but discharge limits may be promulgated if adverse impacts are directly linked to aquatic life.

E.coli:

Current disinfection requirements for the recreational designated use standard of the Mississippi River require compliance with a fecal coliform limit. The DNR is developing E.coli requirements to better reflect the desired health standard.

Although future E.coli limits are not drafted, the new limits are being proposed as though no change is required to effluent disinfection technologies or capacity. However, initial testing by some facilities has indicated there are varying correlations between fecal coliform and E.coli. It is recommended the City develop their own split sample testing analysis to better substantiate a disinfection limit change.

Biosolids Disposal Regulatory Issues

Land Application Phosphorus Restrictions:

Historically, the land application of municipal biosolids has always been well managed, and applied at agronomic crop uptake rates for nitrogen. The Wisconsin Administrative Code (WAC) section NR 151 (which established more stringent runoff management practices) requires nutrient management plans for specific farming practices. As of 2017, La Crosse County had 47% of cropland participating in Nutrient Management Plans.

If applicable to acres where the City land applies biosolids, these regulations would significantly increase the costs for land application of biosolids. The change would require consideration for agronomic rates of phosphorus and require two to three times the area for land application of the same quantity of biosolids. Additionally, the farmers are not always satisfied accepting biosolids at a reduced concentration because the crop may still require additional nitrogen fertilizer. Future planning efforts should consider alternatives to resolve this issue.

Class A Biosolids:

The current practice of mesophilic anaerobic digestion produces a Class B biosolid. The City consistently achieves the required 38 percent volatile solids reduction for surface land application, but to ensure minimal odor impact to the neighborhood, the City injects the biosolids upon land application. Farmers have historically accepted the Class B biosolids as a nutrient supplement.

Isolated problems with Class B biosolids throughout the nation have prompted a discussion to promulgate Class A biosolids to all WWTPs. However, this movement has not gained momentum because Class B land application is deemed safe by both State and Federal regulators and most local public. The City has observed some local governments attempt to ban biosolids land application in certain townships.

While Class A biosolids are not required at this time, it should be noted that a Class A product may be required in the future due to regulatory changes, public acceptance issues, or the defined need to increase the flexibility of the City's biosolids disposal/reuse program, such as developing an alternative end use product.

Technical Memorandum 4
System Needs
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernie Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
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Purpose

Technical Memorandum No. 4 (TM 4) documents the System Needs of the Isle La Plume Wastewater Treatment Facility (WWTF) based on a combination of historical performance, Wisconsin Administrative Code guidelines, typical wastewater treatment industry design criteria and previous WWTF studies. The system needs will serve as the foundation on which decisions are made for future improvements at the WPCF.

This TM reviews each unit process with regard to condition, capacity, and regulatory requirements.

Condition

Several major components (tanks and buildings) date back to 1936, 1952, and 1972. The majority of the mechanical systems within each structure are from the 1972 era; however, a higher proportion of the City's budget is now being directed at equipment replacement as these systems reach their end of life. It is undeniable that these facilities have provided great value to the rate payers and that future improvements will be developed in an effort to continue maximizing these investments. Items identified herein as a condition deficiency are showing signs of age and will need to be budgeted for repair or replacement during the planning period.

In addition to each system's remaining useful life, the condition section also considers each unit process for treatment performance and energy efficiency. The majority of the performance discussion herein will be focused on functionality. Energy efficiency is intended to be an integral part of all components and potential improvements, but such that it does not impart undue complexity or limit the capacity or function of the WWTF treatment objectives.

Capacity

The WWTF must maintain adequate capacity to serve the rate payers, with particular importance towards capacity to accept population growth and industrial growth.

A detailed Unit Process Capacity Summary was developed as part of the WWTP ReRate Study, depicted in Figure 1. The graphic defines units with insufficient capacity being below the green line. Each segment assesses the performance of each unit process based on historical data and identifies maximum code related capacity and expected performance with no modifications. Capacity issues are summarized and described for each unit process throughout the sections below.

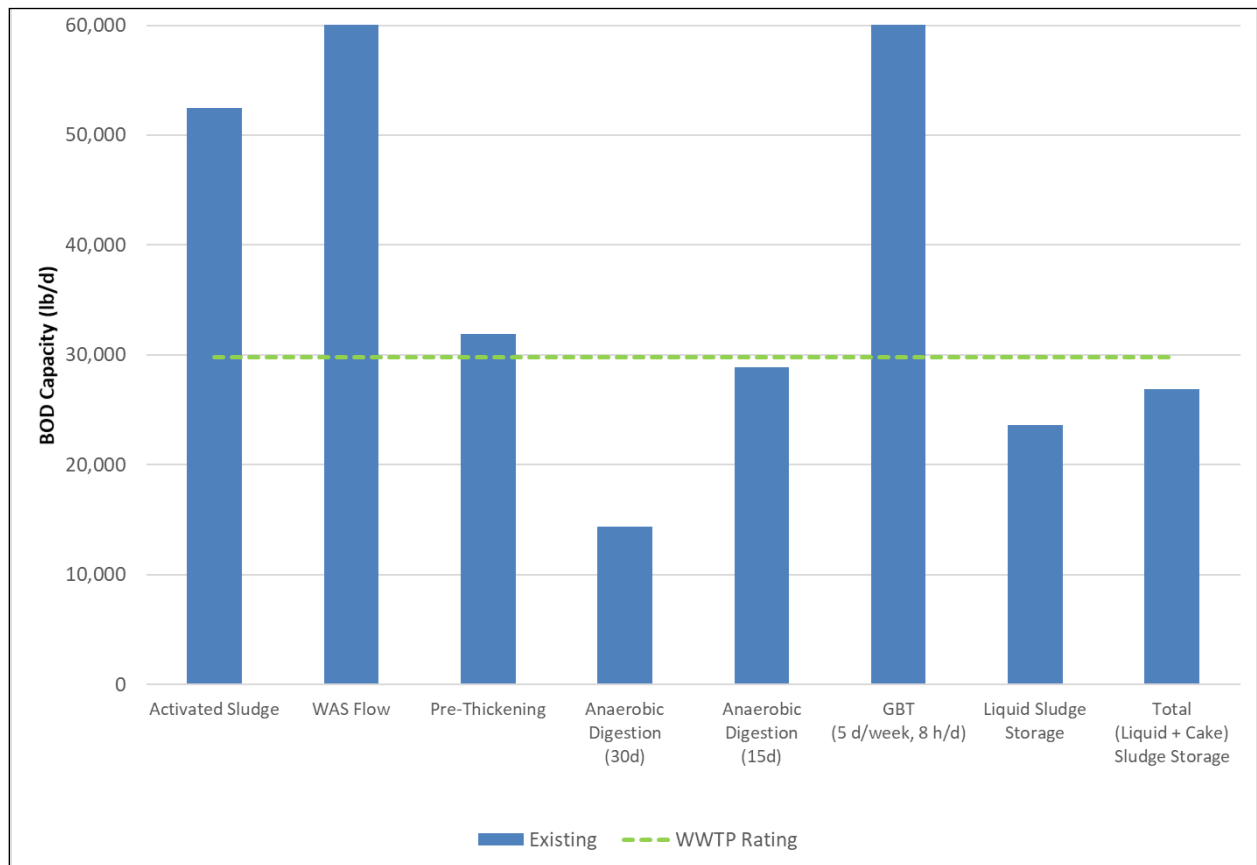


Figure 1 – Solids Handling Unit Process Capacity Summary

Regulatory Concerns

Future regulatory concerns were identified and discussed in TM3. The parameters identified as near-term system needs include effluent phosphorus and effluent E.coli. These items are either already on a compliance schedule, or anticipated on future permit renewals.

Longer term system needs include parameters that have not yet developed into regulatory requirements, but signals in the industry point towards potential (yet undefined extent or timing) for permit changes. These parameters include effluent total nitrogen, Class A biosolids, and phosphorus based land application of biosolids.

Unit Processes

Preliminary Treatment:

Influent Screening

The design basis for influent screening system is based around influent flow, and are not expected to have any capacity concerns within the next 20 years. However, there facility has multiple operational shortcomings, including the lack of an influent flowmeter and grit depositing upstream of the comminutor system. To address these concerns, a flowmeter should be installed and the comminutor overhauled or completely replaced as the system has been in place since 1970.

The screens themselves, while not in bad condition, should be considered for rehaul or replacement with a finer screen, as the existing ¼-inch screen allows significant amounts of debris to pass through.

Raw Wastewater Pumping

The raw wastewater (RWW) pumping system is currently not a major cause for concern for plant staff, and was capable of handling 32 MGD of flow during a 4 inch rain event in 2017 with higher flows observed in 2007. With a firm pumping capacity of 46 mgd spread across five installed pumps, the plant is well equipped for RWW flows. However, this equipment has aged significantly since installation in 1970, and should be considered for replacement or rehabilitation within the next 20 years.

Grit Removal

Grit is removed via two basins and disposed of using grit classifiers. The design capacity of 20 mgd will service the plant for the forecasted period

Preliminary Treatment Summary of System Needs:

Condition:

- Single 6mm step screen does not capture all debris.
- Comminutors old and debilitated.
- Age of some equipment.

Capacity:

- None

Regulatory:

- None

Primary Treatment:

Primary Clarification

Primary treatment is typically operated with two circular clarifiers from the 1970's with a diameter of 90 ft and side water depth of 12 ft. These clarifiers can meet 12.7 MGD average daily flows at the surface overflow rate (SOR) limit of 1000 gpd/ft² set by the Wisconsin Administrative Code (NR 110). These clarifiers are adequate for current average flows and projected 2040 flows of 11.1 MGD.

Current operations limit clarifiers in service and restricts rated capacity for handling peak flows. For example, in 2017 the peak hourly rate was 32.3 MGD. Using only Primary Clarifier No. 4 and 5, results in a SOR of 2,539 gpd/ft², while the maximum recommended rate is 1,500 gpd/ft². During this peak event, the capacity exceedance causes reduced primary clarifier removal rates for BOD, which must be absorbed by the secondary treatment system.

The additional three clarifiers that are not used in typical operation, can be used to equalize flows in maintenance periods. If operations expand to include even a limited number of these clarifiers during peak hourly flows, the primary treatment system will meet code guidelines at projected flows. If all existing primary clarifiers are integrated, the plant will meet code in 2040 at with 1,429 gpd/ft² at 35.6 MGD but will continue to fail to meet the rated peak plant capacity of 44 MGD.

Primary Treatment Summary of System Needs:

Condition:

- Unknown primary sludge database
- Age of some equipment.

Capacity:

- Peak hourly flow requirements are not met by the current operational strategy. Consider methods to maximize this capacity for peak events.

Regulatory:

- None

Secondary Treatment:

Activated Sludge Secondary Treatment

The activated sludge process has five unit processes that are critical to the system: the aeration tanks, the aeration blowers, the final clarifiers, the WAS pumps, and the RAS pumps. Many of these processes were assessed as part of a facility re-rate in 2016. This review found that the activated sludge system was fully capable of handling current loads; however, it is currently incapable of meeting the expected future phosphorus regulatory limits.

The aeration tanks, are capable of handling an average daily loading of 36,500 lb BOD/d in the primary effluent. This is adequate for handling the 2040 projection of primary effluent BOD loadings. This holds true for the blowers as well, which are capable of handling an average daily loading of 39,300 lb BOD/d. The aeration system also has sufficient capacity, but suffers from a lack of operational options due to aeration control and blower constraints.

The four final clarifiers have more than adequate capacity for the projected MLSS goals, and have some margins for change in MLSS capacity based on operational changes for regulatory impacts. The primary problems facing the final clarifiers include the lack of flocculating energy dissipating inlets, imbalanced flow distribution, and algae control.

The WAS pumping flow is expected to increase in direct relation to increase in BOD loads. Since primary effluent BOD is not expected to increase significantly, capacity is not a concern since the pumps typically operate at only 21% of their total capacity. While these pumps were not noted for poor condition, they were installed in 1970 and should be considered for replacement to ensure reliability.

Secondary Treatment Summary of System Needs:

Condition:

- Total phosphorus removal efficiency inadequate.
- Consider airflow control efficiency improvements if reconfiguring the basins
- Clarifier flow imbalance and lack of modern upgrades.
- Clarifier algae control
- Age of some equipment.

Capacity:

- RAS pumping is limited, but adequate for historical needs

Regulatory:

- Potential total nitrogen reductions.

Tertiary Treatment:

Filtration

Secondary effluent filtration facilities are not available, but are required to comply with future regulatory phosphorus requirements.

Tertiary Treatment Summary of System Needs:

Condition:

- Not applicable

Capacity:

- Mass balance for phosphorus needs and inclusive of any trading partners.

Regulatory:

- Total phosphorus compliance with 0.1 mg/L TP by 2024

Disinfection:

Ultraviolet Light Disinfection

The UV disinfection system is made up of three channels and has a peak hour capacity of 42 MGD, which is above peak flows observed or projected at the WWTP. In addition, plant staff feel comfortable with the replacement part acquisition process given that City owns extra equipment models not currently in service. This will likely run out at some point in the next 20 years, at which point spare part availability will have to be reassessed.

Disinfection Summary of System Needs:

Condition:

- None

Capacity:

- None

Regulatory:

- Considerations towards future E.coli compliance. Perform supplemental sampling/analysis.

Raw Sludge Thickening:

Gravity Thickeners

Raw primary sludge and WAS are co-thickened in two circular, 50-foot diameter gravity thickeners before being fed to the anaerobic digestion process. Thickener overflow is recycled to the settled sewage pump wetwell to the activated sludge system. Due to nearly year round nitrifying operation, the thickeners have been able to exceed expectations of the 2010 study and pass yearly flows of 11 MGD. In addition, despite the equipment and infrastructure being installed in 1970, plant staff have not had outstanding issues with the condition of the process.

However, projections show a potential increase in loading from the current 36,000 lb/d by 15,000 lb/d. This is due to increased TSS in the system, the majority of which will settle out in the primaries and raise the SOR making it somewhat more manageable. The issues caused by this could begin to appear relatively quickly depending on industry pretreatment and will persist to 2040 if not resolved.

The other major issue of the gravity thickeners is that they produce too much sludge for downstream processes to operate as they should. This issue could be resolved by producing thicker sludge instead of reworking downstream processes.

Raw Sludge Thickening Summary of System Needs:

Condition:

- Age of some equipment.
- Improve thickened sludge concentration to increase digestion capacity.

Capacity:

- Projected increase to TSS loadings not expected to exceed capacity, but may limit performance.

Regulatory:

- None.
- If revisions occur, consider provisions to increase WWTF TP removal.

Sludge Stabilization:

Anaerobic Digestion

After processing through the gravity thickeners, the sludge is fed into the four anaerobic digesters for stabilization. These digesters are operated in parallel and have varying specifications, with digesters 1 and 4 being smaller than 2 and 3 (430,000 gal versus 700,000 gal) and digesters 1 through 3 having floating steel covers and Digester 4 having a skirted gas holding cover. Gas generated in the digesters is fed to boilers to provide energy heat to facilities and the sludge heat exchanger.

The condition of the digesters is adequate after a series of rehabs these last few years. The major concern is the lack of digester mixing beyond the limited amount provided by recirculation through the sludge heating system.

Capacity is a major concern for the digesters due to hydraulic loading. They are currently under capacity, and this problem will only become more troubling as TSS increases.

Sludge Stabilization Summary of System Needs:

Condition:

- Digestion is adequate for current loadings
- Digesters should have mechanical mixing systems if thicker sludge is generated
- Review digester gas utilization options

Capacity:

- Hydraulic loading limited.

Regulatory:

- Consideration for long-term Class A biosolids as regulatory or for alternative disposal options.

Biosolids Thickening and Dewatering:

Gravity Belt Thickeners

The gravity belt thickening (GBT) process is currently one of two potential destinations for digested sludge. The single 2-meter GBT installed in 1998, and does not have any outstanding maintenance issues. The thickeners are oversized for the flow leaving the digester, being sized for 700 gpm and 3,700 lbs/hr receiving slightly more than 100 gpm and 1,600 lbs/hr. For current use, the thickeners are well positioned to serve for many more years.

Biosolids Dewatering - Belt Filter Press

The dewatering process is composed of single 2-meter belt filter press (BFP) which is fed from either the digester or the liquid sludge storage facility. The process reaches 20-23% or 15-18% total solids for digester or thickened sludge respectively. The process has seen increased use since the 2010 study to decrease the stress on the sludge thickening train. The BFP capacity of 120 gpm and 2,500 lbs/hr is not as large as the GBT, but is still capable of handling loads from the digester.

Biosolids Thickening and Dewatering Summary of System Needs:

Condition:

- Avoid dewatering of liquid storage tanks (reduced performance)
- Dewatering operation is restricted due to shuttle truck capacity

Capacity:

- None

Regulatory:

- None

Biosolids Storage and Reuse:

Liquid Biosolids Storage

Digested sludge that is thickened in the GBT is stored for land application or further dewatering in the biosolids storage facility. This facility consists of two 3-million gallon liquid storage tanks, with pumps in the lower level of the connecting building to accomplish mixing and truck loading. The tanks and pumps have no outstanding condition issues requiring resolution.

These facilities are sized at 150-180 days of storage capacity, typically operating under the 180-days capacity recommended by the Wisconsin Administrative Code. This could be driven down as far as 100 days in the near future as local industries expect to increase TSS loads. These issues have led to a tight storage situation with semi annual hauling.

Cake Biosolids Storage

The cake biosolids storage facility provides 30 days of sludge storage at 20% total solids. While the structure was being used as a garage in 2010, increased BOD has placed demands that the liquid biosolids storage process is not capable of handling. Despite opening up the cake storage facility, capacity persists as an issue.

In addition to the ongoing capacity issues with sludge storage, the location of this facility is an issue as well. The storage building is located 400 ft from the dewatering building, increasing traffic through the area.

Biosolids Storage and Reuse Summary of System Needs:

Condition:

- Cake storage located far from dewatering facility.
- Dewatered cake from liquid storage remains very wet

Capacity:

- Increase liquid and/or cake storage to provide ability to skip one season of land application (330-365 days storage)
- Consider adding capacity to dispose biosolids without weather limitations

Regulatory:

- Increased acres required for land application due to phosphorus

Site:

Utilities

The electrical needs of the WWTF are met by Xcel Energy through three power feeds serving the main WWTF, blower building, and the UV building. The plant consumes energy at a rate of 1473 kWh/MGD which represents a normalized rate per the amount of wastewater treated. In comparison to the best practice benchmark established by Focus on Energy, 1760 kWh/MGD, the City is well run, yet realizes there is always room for improvement. The normalized power draw for the load treated is 572 kWh/1000lb BOD, much lower than the target of 900 kWh/1000 lb BOD. Power redundancy is provided via four backup generators, one at each main service and another serving preliminary treatment. The two main generators are nearing the end of their useful life and should be budgeted for replacement. A new generator for operation of the process blowers should be considered.

Data communications are provided through a fiber optic network, with the exception of collection system lift stations which use radio. This is a noted issue for the City, as radio signals in the area are unreliable due to terrain.

Currently the plant uses effluent water throughout the plant. Consider methods to increase the non-potable (W3) water reuse system upon tertiary treatment installation.

Natural gas is also provided from Xcel Energy. With an expanded W3 system, building heat could be provided by a heat pump or from digester gas to reduce dependence on fossil fuels like natural gas.

NFPA 820

A number of environmental rating concerns noted in past evaluations need to be addressed by the City for the continued health and safety of plant staff. Structures with major concerns include the administration building, the primary effluent pump building, the anaerobic digester complex, the dewatering building, and the liquid biosolids storage complex. The major causes for concern are inadequate separation of rated spaces from electrical and non-explosion proof equipment, improper handling of digester and natural gasses, and insufficient or absent continuous ventilation.

The full notes of an extensive 2008 site visit are included in Appendix A, which gives a comprehensive overview of plant structural, process, electrical, HVAC and plumbing shortfalls. Many of these have yet to be resolved.

Environmental Restrictions

The WWTF is constructed on an old landfill on an island within the Mississippi river, with development east and west of the river. All of these factors play into concern of the plant. Flooding from the river is a known threat, but the plant does not sit in the flood way according to studies by FEMA. In addition, no critical areas are vulnerable to a 100 year flood; however some are vulnerable to a 500 year flood. A full site survey could identify these risks with increased certainty.

The Isle La Plume has been noted to be originally an old landfill prior to development as the WWTF. Although the debris has not been observed to create differential settlement, it has been suspected to contribute to elevated mercury levels during periods of high river stage (groundwater). The high

groundwater leaks in through the building walls and cause the structural sump pumps to engage, which could be a reason that the effluent mercury is higher than the influent mercury at times. Tertiary systems for low-level TP may assist with mercury removal.

The WWTF is situated on the west edge of the City and odors are a continual concern to be attentive to the rate payers. Despite this concern, the facility does not currently mitigate odors with treatment. In recent years, the majority of odor complaints have been due to odorous activities taking place at City Brewery.

Site Summary of System Needs:

Condition:

- Decrease reliance on City's water supply, consider expanding the non-potable (W3) system.
- Multiple rating issues caused by inadequate ventilation or area segregation.
- Age of some equipment.
- Monitor flooding concerns for all new structures.

Capacity:

- N/A.

Regulatory:

- Monitor mercury and address areas as needed to continue variance. Size TP tertiary filter system to optimize mercury removal.

Administration Building / Screens/Grit Wash/Offices/Lab/GBT– Grade Level

Structural –

- The room which houses the generator, adjacent to the administrative spaces, is separated from the rest of the building by wood frame walls. This construction should be reviewed. Installations of stationary combustion engines require a 1-hour fire wall separation between differing occupancies.
- The control joint in the masonry above the north end of the lintel over the east access door to the Screen/Grit Wash stand by generator room has opened up approximately ¼ inch. This is probably due to differential settlement of that portion of the building addition with respect to the deeper portion of the addition. This joint should be re-caulked inside and out and monitored to determine if additional movement takes place.
- The roofing and insulation over the original Plant #1 needs to be removed and replaced. A ballasted loose laid EPDM membrane is recommended.
- There is some cracking in the masonry parapet along the north face of the building, just above the east end of the east garage door. This deterioration should be repaired.
- Along the south wall just north of clarifiers #1 & #2, there is some deterioration of the brick joints near the top of the wall. This area should be tuck pointed to minimize future damage to the wall.
- If changes are made to this facility with respect to electrical classification issues, it may be necessary to update the means of egress from the building. This would possible include changes to the means of egress to the intermediate and lower levels.

Process –

- Preliminary treatment equipment in the Administration building is newer and clean. Equipment consists of comminutors, screens, screenings washer/compactor, and grit washers.
- Some corrosion problems were noted, but did not appear to be significant.
- The idea of changing the valve of the grit washer from 4-inch diameter to 6-inch diameter was discussed as a possible way of reducing clogging problems.



Electrical –

- The new headworks/screen building addition should be a class I, division 1, Group D hazardous classified location per the Nation Fire Protection Association standard 820 (NFPA 820). Currently the process equipment, electrical equipment, lighting, conduit system, etc is not suitable for a class I, division 1, group D hazardous classified location.

Site Visit Notes
September 25, 2008
La Crosse, WI

- NFPA 820 requires the headworks/screen addition to be “physically separate” from unclassified areas like the administration area of the building. This means that there should be no means for gas to migrate from the headworks/screen addition to the rest of the building. The headwork/screen addition does have separate exterior access but there is not a gas tight partition between the headworks/screen addition and the remainder of the building. The electrical conduit system does not have explosion proof seal offs that provide a gas tight seal and prevent gas from migrating to the administration building. Gas from the headworks/screen addition could migrate to the remainder of the building through the conduit system and fill the unclassified area with methane. As a result the remainder of the building would be rated the same as the headworks/screen room which is a class I, division 1, group D hazardous classified location.
- The generator room attached to the headworks/screen addition is not “physically separate” from the headworks/screen addition. The generator room does have separate exterior access but there is not a gas tight partition between the generator room and the headworks/screen room. The electrical conduit system does not have explosion proof seal offs that provide a gas tight seal and prevent gas from migrating into the generator room. As a result the generator room would be rated the same as the headworks/screen room which is a class I, division 1, group D hazardous classified location.
- Electrical motor control centers and variable frequency drives are located at grade in the room directly above the dry well where the raw wastewater pumps are located. The exposed copper inside the electrical equipment in this area is black with corrosion due to hydrogen sulfide.



Plumbing – No comments.

HVAC –

- A natural gas fired unit heater is installed within the Screen/Grit Room space. This space should be considered a hazardous classified space and should not have a gas fired appliance installed within it.
- Ventilation rates should be confirmed in the Screen Room space to ensure that the 10 States Standard required ventilation rate of 12 AC/Hr continuous or 30 AC/Hr intermittent are provided.
- Staff indicated that the new make-up air units (vertical Titan units) are problematic, wearing through belts to frequently and corroded sensors causing nuisance trips.
- The Electrical Room is cooled by split system air conditioning units with no outside air capability. This was done because of corrosion of the electrical gear from the previously installed outside air ventilation systems.
- The Electrical Room and the rest of the grade level administrative spaces are physically connected to the drywell area of the pump station. Because of this, all these interconnected spaces require 6 AC/Hr of continuous outside air ventilation

Site Visit Notes
September 25, 2008
La Crosse, WI



to be considered Unclassified spaces. Lesser ventilation rates would require the spaces to be considered a Class 1, Division 2 hazardous environment. It appears that the existing ventilation systems are less than code required ventilation rates for an Unclassified rating.

- The room which houses the generator, adjacent to the administrative spaces, appears to be under ventilated resulting in elevated temperatures when the generator runs.
- The Thickener Room interior air was very foul, indicating inadequate ventilation. Ventilation rates should be reviewed to confirm that 10 State Standards recommended minimum ventilation rate of 12 AC/Hr continuous or 30 AC/Hr intermittent is provided. Existing ventilating systems had minimal ductwork installed allowing for poor distribution of airflow which is probably a contributing factor to the elevated odor levels.
- Staining of the ceiling tiles was noticed in the Break Room. Inspection indicated that this was probably created by uninsulated branch take-offs from the main supply duct causing condensation and dripping.
- Staff indicated that the rooftop heating and cooling units serving the Lab and Break Room areas function adequately.

Administration Building – Intermediate Level

Structural –

- The spiral stair cases to the intermediate and lower levels do not meet current code with respect to egress. As long as significant changes are not made to the spaces or the occupancy of the spaces is not changed, code compliant stairs are not required.

Process –

- Five vertical centrifugal pumps lift the raw wastewater. Three of the five are driven by VFDs. The #4 pump is not operational because of problems with check valve slamming. Pumps #4 and #5 are not driven by VFDs, but #5 does not have the same plugging problems as the #4 pump. New motor and a VFD for the #4 pump is expected to be installed in the next 2-3 years. There is one spot left for installation of a VFD.
- The old 'detroit' room is mostly empty and used for some storage. This space could be used for other process purposes if needed.
- Inclusion of the lab area in the plan was discussed on the tour. The owner does not have process concerns regarding the lab, but it is thought that including it in the plan is not a bad idea.



Electrical –

- See lower level. The intermediate level is connected to the lower level and should be the same rating as the lower level.

Site Visit Notes
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La Crosse, WI

Plumbing – No comments.

HVAC – See Lower Level.

Administration Building/Screens/RWW Pumps– Lower Level

Structural – See intermediate level.

Process –

- A digester gas pipe routed though the lower level is constructed of HDPE materials. International fuel gas code requires metallic piping systems for indoor gas piping.
- The digester gas pipe is routed in such a way that low points are created making potential traps for condensate. No means of draining the lines were found.

Electrical –

- The lower level contains raw wastewater pumps. Per NFPA 820 the lower level should be a class I, division 2, Group D hazardous classified unless the lower level and connected spaces are ventilated continuously with 100% outside air at 6 air changes per hour (AC/hr). Any spaces connected to the lower level and not “physically separate” (no means for gas migration between spaces) from the lower level should also be a class I, division 2, Group D hazardous classified location. The electrical and process equipment in the lower level does not appear to be suitable for a class 1, division 2, group D hazardous classified location.
- Since the lower level is “physically connected” to the rest of the administration building, the entire administration building should be a class 1, division 2, group D hazardous classified location. The electrical and process equipment in the administration building does not appear to be suitable for a class 1, division 2, group D hazardous classified location.
- The lighting in the lower level is older fixtures and in some areas there is not enough adequate light.



Plumbing – No comments.

HVAC –

- There appears to be inadequate ventilation of the lower level. 10 States Standards requires 6 AC/Hr continuous or 30 AC/Hr intermittent ventilation for below grade drywell spaces. NFPA 820 requires a continuous ventilation of 6 AC/Hr for the space to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Administration Building – Pista Grit/Wastewater Wet Well

Structural – No comments.

Process –

- Two vortex type Pista Grit systems were upgraded and refurbished about six years ago. Design capacity of the grit system is 20 MGD and the chambers are alternated daily.
- The discharge pipe that carries grit to the washer plug tends to plug. Operators try to prevent the plugging by monitoring the fill rate of the grit wash tank.
- SCADA is used to record functions of the process and the grit wash tank is inspected two or three times daily.
- Recycle process water is returned to the head of the plant at manholes outside of the headworks generator room. These flows come from the gravity belt thickener (GBT), belt filter press (BFP) or centrifuges (which aren't currently used).

Electrical –

- Per NFPA 820 the pista grit area should be rated a class 1, division 2, group D, hazardous classified location in the area 18 inches above the channels extending out 10'0" from the edge of the channels. Outside of this area is unclassified.
- The conduit systems in this classified area do not contain explosion proof seal-offs. The electrical equipment on the pista grit area and adjacent to the pista grit area within the classified area is not rated for a class 1, division 2, group D, hazardous classified location.
- The exposed copper ground conductors in this area are black with corrosion due to hydrogen sulfide.
- Some of the conduit in the area adjacent to the pista grit area near the padmount transformer is rusted and corroded.



Plumbing – No comments.

HVAC – No comments.

Primary Clarifiers

Structural – No comments.

Process –

- There are five primary clarifiers. Two rectangular and one circular are older and there are two newer circular clarifiers. Operators monitor water temperature in the unused clarifiers to catch ice and freezing problems.
- Operators have found that problems with grease build-up and hydrogen sulfide formation are reduced when only two clarifiers are in operation, as opposed to three or five in operation. This new approach has been used for the past year.
- The clarifiers are cycled in and out of operation.

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- Water is kept in the unused clarifiers to protect against floating caused by high ground water.

Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Primary Effluent Pump Building/Blowers/Generator/Motors- Grade Level

Structural –

- The roofing and insulation on this building (Plant #2) needs to be removed and replaced. A ballasted loose laid EPDM membrane is recommended.
- The slab on grade floor is cracked in the vicinity of the blowers. The blowers sit directly on the floor, and are not supported by isolated equipment pads. This area should be monitored to determine if additional cracking occurs or settlement of the blowers occurs. If either happens, it may be necessary to provide isolated pads or vibration isolators.

Process –

- Three of the primary effluent pumps are driven by VFDs and plans to put the #4 pump on a VFD were discussed.

Electrical –

- Sludge pumps in upper level with sludge well below pumps. Sludge well is rated a class 1, division 1, group D, hazardous classified location. Hatch connects sludge well to upper level so building would also be rated a class 1, division 1, group D, hazardous classified location per NFPA 820. Electrical and process equipment in building not suitable for a class 1, division 1, group D, hazardous classified location.

Plumbing – No comments.

HVAC –

- The sludge pumps are vertical type penetrating the floor into a sludge well below. There are access hatches to the sludge wells within the space. The sludge wells are considered a Class 1, Division 1 hazardous environment and because of the interconnection provided by the access hatches, the entire structure should carry the same hazardous rating.
- The Generator Room and Blower Room seemed to have inadequate ventilation to provide cooling of the spaces.
- Because of the below grade sludge pumps and the lack of physical separation, the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.



Primary Effluent Pump Building Intermediate Level

Structural – No comments.

Process – No comments.

Electrical – No comments.

Plumbing – No comments.

HVAC – See Lower Level.

Primary Effluent Pump Building Effluent Pumps Lower Level

Structural – No comments.

Process –

- The thickened sludge pumps and piping were being replaced at the time of the facility tour.

Electrical –

- Sludge pumps in lower level. Per NFPA 820 the lower level should be rated a class 1, division 2, group D, hazardous classified location unless the lower level and connected spaces are ventilated continuously with 100% outside air at 6 air changes per hour (AC/hr). Any spaces connected to the lower level and not “physically separate” (no means for gas migration between spaces) from the lower level should also be a class I, division 2, Group D hazardous classified location.



Plumbing – No comments.

HVAC –

- Because of the below grade sludge pumps the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. No continuous ventilation systems were noticed. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Aerations Tanks

Structural –

- The walls and or walkways have experienced some deterioration at the north and south ends of the walkways where they sit on the tank walls. This deterioration is most likely the result of differential movement between the walkway and tank wall. This movement is most like caused by expansion and contraction of the walkways. The north end of the west walkway is the most severely deteriorated. At this location, there is a 4 ft square by 3 inch deep spall on the inside face.
- The old steel pipe air header needs to be repainted.



Process –

- Sludge wasting for the activated sludge process is based on $\text{NH}_3\text{-N}$.
- Two blowers are needed to maintain the target DO of 1.5 mg/L at the head end of the aerated zone. DO at the effluent end of the aeration zone is operated around 6-7 mg/L.
- The Norton stone fine bubble diffusers tend to plug more if the air flow from the blowers is throttled.
- Redmon Engineering visited the site the previous week to conduct off-gas studies of the aeration basins.

Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Secondary Clarifiers

Structural – No comments.

Process –

- Effluent from the clarifiers flows through an open tank in the old chlorine contact tank. Growth of algae was observed in this tank.
- Algae growth was observed on the weirs and launders of the final clarifiers.

Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Effluent Disinfection UV Building

Structural – No comments.

Process –

- The UV disinfection system was supplied by Wedeco and replaced a Fisher-Porter system from the early '90s.

Electrical – No comments.

Plumbing – No comments.

HVAC –

- There is no continuous ventilation for the UV Room. High moisture levels were noticed, but plant staff indicated there have been no issues within the space. General Corrosion was evident but would not be considered significant.
- A continuous ventilation system was installed for the air space between the channels and the cover system. This ventilation system reduces the moisture released to the room above. Staff has indicated that the fan exhausting this system has significant icing issues during cold weather. Consideration should be given to providing a continuous tempered air supply to the UV room that would pressurize the space. This supply air should be drawn done through the cover system to temper the air which is exhausted. This should improve humidity levels in the UV Room and reduce the likelihood of icing the exhaust fan in the winter.

Gravity Thickeners

Structural – No comments.

Process –

- Sludge from the primary clarifiers and waste activated sludge are co-thickened in the Gravity Thickeners.

Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Anaerobic Digesters

Structural –

- The roofing and insulation over the building portion of the complex needs to be removed and replaced. A ballasted loose laid EPDM membrane is recommended.
- The exterior surface of the Digester #4 floating cover (top and skirt) needs to be repainted.
- The interior surfaces of all four digesters should be cleaned and inspected to determine if structural repairs and repainting are required.



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Process –

- Gas handling equipment, including condensate traps and control valves are installed within the main gallery space which is physically connected to the rest of the structure. Locations with gas handling equipment installed should be physically separated from the rest of the structure and treated as a Class 1, Division 1, hazardous environment.
- The four digesters are operated as primary, single stage, mesophilic processes.
- Digesters are fed on a two hour cycle. Each digester is heated, recirculated and fed 12 times per day.
- Covers on digesters 1, 2 and 3 need to be replaced.
- The waste gas burner was installed 8-9 years ago. Capacity of the burner or piping problems feeding the burner limits it to a maximum observed flow of 6000 cf/hr. More burner capacity is needed.
- Only one digester can be heated at a time using the two heat exchangers that are connected in series. The two heat exchangers are near the end of their useful service life.
- The sludge heaters do not have automatic temperature control.
- Sludge feed from the gravity thickeners of greater than 3% TS causes recirculation problems with the digestion process.



Electrical –

- Per NFPA 820 drip traps and condensation traps make a space rated a class 1, division 1, group D, Hazardous classified location. Drip traps and condensate traps located in digester building making it a class 1, division 1, group D, Hazardous classified location.
- Per NFPA 820 the area 10'-0" above a digester tank is a class 1, division 1, group D, hazardous classified location along with the area 5'-0" out horizontally from the digester tank walls. Per NFPA 820 the area between 10'-0" and 15'-0" above a digester tank is a class 1, division 2, group D, hazardous classified location along with the area between 5'-0" and 10'-0" out horizontally from the digester tank walls. The electrical and I&C equipment in this area does not appear to be suitable for the hazardous classified location

Plumbing – No comments.

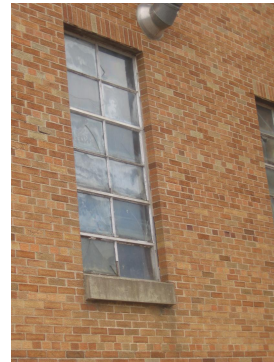
HVAC –

- No means of continuous ventilation noticed. NFPA 820 requires a continuous ventilation rate of 6 AC/Hr in spaces containing digester gas piping and gas utilization equipment (boilers) to be considered a Unclassified area, otherwise the space should be treated as a Class 1, Division 2 hazardous space.

Dewatering Building (Belt Press) Grade Level

Structural –

- The windows in this building are old and in some instances missing panes of glass. Consideration should be made to remove and replace the windows with modern windows or glass block.



Process –

- The belt press and centrifuges are not currently used to dewater sludge. The belt press was last used in 2006 and the centrifuges have not been used since 2005.

Electrical –

- The lower level contains sludge pumps. Per NFPA 820 the lower level should be a class I, division 2, Group D hazardous classified unless the lower level and connected spaces are ventilated continuously with 100% outside air at 6 air changes per hour (AC/hr). Any spaces connected to the lower level and not “physically separate” (no means for gas migration between spaces) from the lower level should also be a class I, division 2, Group D hazardous classified location. The electrical and process equipment in the lower level does not appear to be suitable for a class 1, division 2, group D hazardous classified location.
- The two motor control centers not located in the separate control room are old and obsolete.

Plumbing – No comments.

HVAC –

- No means of continuous ventilation were noticed in the facility. 10 States Standards recommends a continuous ventilation rate of 12 AC/Hr or intermittent rate of 30 AC/Hr for sludge dewatering spaces.
- Because of the below grade sludge pumps the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. No continuous ventilation systems were noticed. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Dewatering Building Upper Level

Structural – No comments.

Process – No Comments.

Electrical – No Comments.

Plumbing – No Comments.

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HVAC –

- Because of the below grade sludge pumps and the lack of physical separation, the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Liquid Biosolids Storage Building-Grade Level

Structural – No comments.

Process – No Comments.

Electrical –

- See lower level for building rating.
- Since the lower level is “physically connected” to the rest of the building, the entire building should be a class 1, division 2, group D hazardous classified location. The electrical and process equipment in the building does not appear to be suitable for a class 1, division 2, group D hazardous classified location.

Plumbing – No Comments.

HVAC –

- Because of the below grade sludge pumps and the lack of physical separation, the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Liquid Biosolids Storage Building-Lower Level

Structural – No comments.

Process – No Comments.

Electrical –

- The lower level contains sludge pumps. Per NFPA 820 the lower level should be a class I, division 2, Group D hazardous classified unless the lower level and connected spaces are ventilated continuously with 100% outside air at 6 air changes per hour (AC/hr). Any spaces connected to the lower level and not “physically separate” (no means for gas migration between spaces) from the lower level should also be a class I, division 2, Group D hazardous classified location. The electrical and process equipment in the lower level does not appear to be suitable for a class 1, division 2, group D hazardous classified location.



Plumbing – No Comments.

HVAC –

- Because of the below grade sludge pumps the entire structure requires a continuous ventilation rate of 6 AC/Hr to be considered Unclassified, otherwise the space should be considered a Class 1, Division 2 hazardous environment. No continuous ventilation systems were noticed. It did not appear that any of the electrical components installed within the space are suitable for a Class 1, Division 2 hazardous environment.

Liquid Biosolids Storage Tanks

Structural – No comments.

Process –

- The liquid sludge storage tanks are relatively new. They appear to be well maintained and no operational issues were cited based on the current use of these tanks.

Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Cake Sludge Storage Building

Structural – No comments.

Process –

- The cake sludge storage building is in good condition, but it is no longer used to store sludge. Sludge hauling trucks and other equipment are currently stored in this building. The City is considering the sale of the cake slinger trucks.



Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Other Process Structure

Structural – No comments.

Process –

- The facility currently does not use effluent process water for wash-down or other process purposes in the plant. Backflow preventers are in place to provide non-potable process water in the facility and the wastewater utility pays the water utility for the use.
- High strength waste from City Brewery is currently fed directly to the digesters. The waste is fed slowly from a hauling truck. It is very syrupy with a high COD in the range of 150,000 to 200,000 mg/L.
- Grease and septage receiving was discussed. Currently these wastes are discharged into a manhole outside of the grit/screening room. No metering is performed for billing purposes. Billing is done on an honor system. Operators would prefer to have the grease and/or septage receiving on the opposite end of the facility from the current location.



Electrical – No comments.

Plumbing – No comments.

HVAC – No comments.

Plant Site

Structural – No comments.

Process – No Comments.

Electrical – No Comments.

Plumbing –

- There is currently no pumped plant effluent (W3) system installed for process and washdown usage. Plant currently uses city water for all water demands. Consideration should be given to installation of a plant W3 system to offset the costs of city water.

HVAC –

- There are currently two boiler systems in the plant (Administration Building, Digester Building, and Dewatering Building). The boilers serving the Administration Building and the Dewatering Building appeared to near the end of their useful life. Because of this and the close proximity of these structures to each other, consideration should be given to installing a central boiler plant that can provide hot water or steam to each of these structures. System should be connected to the Digester Gas Boiler system to allow the use of digester gas for building heat when excess gas is available.

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- The plant experiences premature failure on their air conditioning condensing unit coils (typical life of 2-3 years). It is assumed this is caused by hydrogen sulfide corrosion of the copper and aluminum coils. Plant staff has asked that a central chiller system be considered to provide cooling water for air conditioned spaces. These are predominantly located in the Administration Building. The practicality of this should be reviewed. If excess digester gas is available in the summer months, possibility of using an adsorption chiller using the waste heat as an energy source for the chilled water supply.



Instrumentation and Control

General –

- The plant is fully PLC controlled and fully automated. All process control operations are handled through the PLC programming and it is only necessary for operator intervention if an unusual condition is detected by the PLC systems located through the plant. It is manned 7 am to 3 pm 5 days a week with the lab manned 7 am to 1 pm on Saturday and a two hour maintenance walk through on Sunday. The PLC control system has a full SCADA system over the top of it monitoring, displaying and controlling the operation of the plant. The SCADA system is connected to a Raeco Dialer system to inform on call personnel of critical alarm information during hour in which the plant is unmanned. The plant personnel also have access to the SCADA system remotely through the City network via a VPN and using Remote Desktop. The communication is Ethernet based with point to point fiber connecting all the remote buildings.
- There is a 900 MHz Serial radio system to monitor critical information from the remote liftstations round the city. The system uses 900 MHz MDS radios with a repeater at City Hall. This information is fully integrated into the Plant SCADA System.

Ethernet System –

- The building to building Ethernet network is Fiber Based. The Fiber is not looped but is point to point from building to building. Inside the building is copper based Ethernet. The plant uses Cisco Ethernet equipment. The system is connected to the overall City network and this has been the cause of a few problems. Some work should be done to separate the control system network from City network traffic.

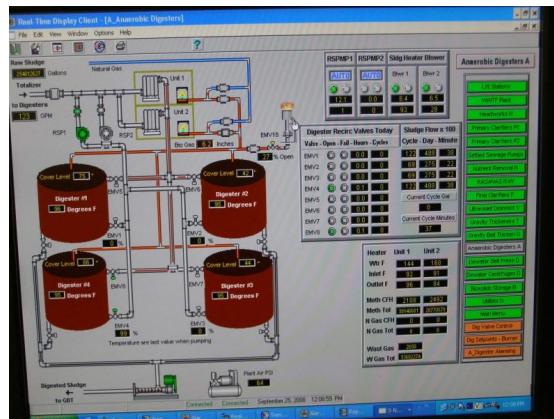
General PLC Systems –

- The Plant PLC system is Ethernet based and uses primarily Allen Bradley SLC 5/05 processors although there is one Allen Bradley ControlLogix Process in the UV Disinfection area. There is also a new CompactLogix processor being installed. Primarily Clarification area to control the new Scum pumps that are being installed.

- On smaller project the plant technicians handle the PLC programming on their own. On large projects the plant uses exclusively LW Allen out of Madison. This arrangement has given the process control system a very uniform and consistent PLC programs which aides in problem detection and troubleshooting.
- The plant is aware of the limited availability of the SLC 5/05 going into the future and the plant is satisfied with both the Compactlogix and Contrologix platforms and going forward will use the model consist with the requirements of the process being controlled. The plant has and knows how to use the programming packages for all the controllers that it has and plans to have in the future.
- The plant has RSLogix 500 programming software for the SLCs and the Micrologix and RSLogix 5000 for the Compact and Contologix along with the programming software for the older Panelviews. They will need to get RSVIEW Studio for the newer Panelview Plus that will be coming in.

SCADA System –

- The HMI software being used at the plant is the FMT Software by Intellisys. It is primarily collecting data from the plant PLC via NetDDE but a conversion is under way to the KEPCORE OPC server. The plant is using several other Intellisys products where applicable. The system is setup for 6 client PCs to view the SCADA system. These are located at strategic locations around the plant. The ReportView is used at the plant for reporting.
- All graphics are well organized, functional and plant personnel are satisfied with the operation of the system.
- The SCADA System is accessible remotely to plant personnel though Sonic wall, a virtual private network and Remote Desktop. So that plant conditions and alarms can be observed and acknowledge.
- The FMT software needs to be upgraded as soon as the new release comes out which should occur end of next year.



Technical Memorandum 5
Alternatives Screening/Retained Alternatives
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
Eric Lynne – Donohue & Associates
Ben Stephens – Donohue & Associates

Purpose

Technical Memorandum No. 5 (TM 5) documents the results of the alternative screening workshop. The purpose of the workshop was to identify potential solutions to program issues and challenges or specific system needs. The system needs were grouped by general categories of each unit process. The workshop process identified and retained creative strategies for meeting the needs of performance, regulatory, capacity, and efficiency constraints at the Isle La Plume Wastewater Treatment Facility (WWTF). This session was intended to be non-judgmental, but rather provide a free exchange of ideas, options, concepts that could meet current and/or future needs.

In developing alternatives for the rehabilitation system needs, many times the best alternative was obvious and therefore only one alternative may be listed. It was agreed that although other potential solutions may exist, the alternatives identified herein are likely the most-feasible and other less-feasible alternatives were omitted to reduce confusion and clutter, but could be considered during detailed design.

For system needs which several improvement options exist, a preliminary screening discussion was performed at the workshop to organize the evaluation into sensible alternatives for detailed review. The final portion of the workshop was devoted to conceptual evaluation/discussion/critique of the lists of potential alternatives, with a goal of screening down to 2-3 alternatives per unit process to be retained for detailed development, costing and evaluation. Alternatives were eliminated from further consideration for a wide range of reasons, including inconsistent with the City's goals and traits, requiring excessive cost, high safety risk, incompatible with current City facilities/operations, unproven or failed technology, etc.

The following section summarizes the alternatives retained for detailed evaluation.

Alternatives List

A shorthand naming scheme was implemented to enhance organization and reference to the various assortment and pairing of alternatives. The following methodology was applied:

- For items that are considered separately implemented choices, a numeral designator was assigned (e.g., 1, 2, or 3).
- For competing alternatives that address a common system need, an alphabetic designator was assigned (e.g., a, b, or c).

The following is a unit-process by unit-process listing of the alternatives:

Headworks

TM4 identified issues related to comminutors performance, grit accumulation in the inactive comminutors channel, expediting grit systems for storm flows, replacement of aging HVAC systems, and providing improved septage receiving facilities for haulers.

- H-1 Fine Screen
- H-2 Grit System Programming
- H-3 HVAC Improvements
- H-4 Septage Receiving

Primary Clarifier

TM4 identified the normally unused primary clarifiers are not in service during peak flows due to poor scum removal systems at those tanks, this alternative resolves this concern.

- PC-1 Scum Pit 3 (Scum Pump) with High Strength Waste

TM4 also noted a need for high strength waste receiving. Subsequent alternatives indicate potential elimination of a gravity thickener, which could be repurposed for high strength wastes fed to anaerobic digestion or activated sludge.

- PC-2 High Strength Waste and Septage Receiving at Gravity Thickener No. 1

Activated Sludge

TM4 identified issues related to selector zone and activated sludge size, efficiency, and treatment performance. Additionally, minor modifications to return activated sludge provide operational control and flexibility to maximize treatment performance.

- AS-1 Activated Sludge Reactor Splitter Box
- AS-2 Large Blade Submersible Selector Mixers
- AS-3 Modified University of Cape Town
- AS-4 Secondary Clarifier Splitter Box
- AS-5a New Submersible Return Activated Sludge Pump Stations
- AS-5b Modify Return Activated Sludge Piping to Minimize Deposition
- AS-6 Secondary Clarifier FEDWA Inlets and Rapid Sludge Withdrawal
- AS-7 Secondary Clarifier Density Current Baffles

Effluent Phosphorus Treatment

TM4 identified issues related to improved tertiary treatment of phosphorus. These alternatives provide filtration and additional chemical addition.

- EP-1a Inside-Out Disk Filter with Coagulation Zones
- EP-1b Outside-In Cloth Disk Filter with Coagulation Zones
- EP-1c Reactive Upflow Sand Filter

TM4 identified concern for algae growth causing excess maintenance and overload to the phosphorus filtration system. This alternative provides covers at each secondary clarifier.

- EP-2 Secondary Clarifier Launder Covers

Disinfection

TM4 identified concern to the reliability of the disinfection system for the extended planning period. For a future placeholder, a replacement UV system was considered.

- DI-1 Replacement of Ultra-Violet System

Sludge Thickening

TM4 identified anaerobic digestion capacity and performance gains by thickening the raw sludges more prior to digestion. These alternatives replace or minimize dependence on the existing gravity thickeners. An overall perspective towards operation with separate thickening or combined thickening was inconclusive to provide a drastic benefit either direction, so each concept was retained for further analysis. Full scale trials of thickening in a combined or separate mode is recommended to validate performance abilities and identify operational concerns.

- ST-1a Combined Raw Sludge Disk Thickening
- ST-1b Separate Waste Activated Sludge Disk Thickening and Struvite Control
- ST-1c Combined Raw Sludge Gravity Belt Thickening
- ST-1d Separate Waste Activated Sludge Gravity Belt Thickening and Struvite Control
- ST-1e Combined Raw Sludge Rotary Drum Thickening
- ST-1f Separate Waste Activated Sludge Rotary Drum Thickening and Struvite Control

Digester Operation, Heating, and Recirculation

TM4 identified issues related to digestion capacity for current and future conditions.

- D-1 Status Quo (Mesophilic, Parallel Feed, Replace Pumps and Heat Exchangers In Kind)
- D-2 Thermophilic Anaerobic Digestion Conversion (One Thermophilic followed by Two or Three Mesophilic)
- D-3 Waste Activated Sludge Conditioning (Temperature and pH) and Potentially 2-3 Mesophilic Digesters

Digester Mixing

TM4 identified issues related to digestion capacity, to increase capacity in the digesters a thicker sludge is recommended, which also dictates improved digester mixing.

- DM-1 Digester 1&4 Draft Tube; Digester 2&3 Jet Mixing

Biosolids Reuse

TM4 identified issues related to the capacity of biosolids storage and the reliability of Class B biosolids land application.

- BR-1a Status Quo (80% Liquid 20% Cake to Land Application)
- BR-1b 15% Total Solids Liquid Handling (approx. 80% Liquid 20% Cake to Land Application)
- BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)
- BR-1cr Increase Cake Handling and Improve Logistics via Remote Cake Storage
- BR-1d Increase Diversity (approx. 50% Liquid 50% Dried Biosolids Belt Dryer, with Cake Optional)
- BR-1e Increase Diversity (approx. 50% Liquid 50% Dried Biosolids Solar, with Cake Optional)
- BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)
- BR-1g Increase Diversity (50% Liquid 50% Cake to Compost)
- BR-2 Improve Biosolids Quality (add raw Sludge Screening)

Biogas

TM4 identified issues related to improving biogas utilization for improved safety of flaring, increased heat energy capture, biogas to electricity, or biogas to renewable natural gas.

- BG-1 Replace Waste Gas Burner
- BG-2 Biogas Storage
- BG-3a Baseline Energy Consumption
- BG-3b Cogeneration Engine
- BG-3c Peak Shaving Cogeneration Engine
- BG-3d Cogeneration Microturbine
- BG-3e Pipeline to Utility

Site and Utilities

TM4 identified issues related to general site utility performance, efficiency, and safety.

- U-1 Replace Facility Wide Heating System
- U-2 Comply with NFPA 820 & 10-State Standards for Buildings
- U-3 Increase W3 System Capacity
- U-4 New Transformers and One Electrical Service
- U-5 Floodplain and Site Access Improvements

TM 6: Alternatives Evaluation will document the detailed evaluation of these alternatives in a manner that will group them into logical elements of the City's current and future wastewater treatment program.

Technical Memorandum 6
Alternatives Analysis
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
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Purpose and Background

Technical Memorandum No. 6 (TM 6) discusses and evaluates the alternatives selected for detailed evaluation for the La Crosse, Isle La Plume Wastewater Treatment Facility (WWTF), which were originally presented in TM 5 and discussed/screened at the Alternative Screening Workshop held December 7, 2018. TM 6 first provides brief background information and then presents detailed alternatives to resolve system needs. Following development of a thorough listing of alternatives, some alternatives were found to be common-sense or stand-alone, while others had a true set of choices between alternatives to address a core system need. These comparison alternatives are contrasted at the end of this TM using Total Present Worth and Non-Economic criteria, which were established in TM1, in a manner that develops a set of recommended improvements for implementation. The timing and financing of these improvements will be discussed in TM 7.

The 2008 Facilities Plan recommended several improvements, some of which have yet to be implemented. All alternatives were reviewed for relevance and priority. Near-term continued use of many of the existing facilities was identified to minimize impact to rate payers. The alternatives also present several mid- to long-term alternatives to provide an increased level of treatment (i.e., sludge stabilization to Class A biosolids). The alternatives are organized by unit-process, each includes a brief description of the proposed system, advantages and disadvantages, and pertinent costs.

The economic evaluations form the basis of cost-effectiveness analyses, and include the estimated cost of constructing the facilities with varying levels of operating costs for a 20-year planning period to treat the projected future flows and loadings identified in TM3.

The annual costs are converted to an equivalent present worth so that comparable alternatives can be evaluated on a total present worth basis. All total present worth costs were derived based on the WDNR prescribed 3.625% discount rate. In this way, alternatives with high initial costs and low operating costs can be compared equally to alternatives that offer low initial costs but may have high operating costs.

The detailed preliminary cost opinions are presented in Appendix A. The cost opinions in general include allowances for undefined design detail related to specific cost categories (civil/site work, mechanical, controls, electrical, etc.). The allowances applied vary between alternatives based on the anticipated amount of work required for each category that was not explicitly listed. The cost opinions also include standard percentage allowances applied to the overall estimated total as follows:

- 30% allowance for undefined design detail.
- 25% for contractor overhead and profit.
- 15% for engineering (design and construction services).

Soil conditions on site were cited to be poor. New buildings were scoped to include pile foundations to a depth of approximately 50-ft. Soil borings from the City's cake storage building project confirmed this assumption.

Alternatives

This technical memorandum documents alternative approaches considered feasible in addressing identified system needs, organized by unit process. The section begins with brief descriptions of the system need, then presents preliminary alternatives to address those deficiencies. The alternatives evaluations conclude by listing those alternatives retained and evaluated during the Alternatives Evaluation Workshop for further consideration in further non-economic detail, from a conceptual implementation standpoint.

Headworks/Preliminary Treatment

H-1 Fine Screen

Purpose and Description

The headworks was upgraded in 2002 with the addition of a ¼-inch fine-opening step screen. The existing comminutors had been retained for back-up service and have provided value well past the equipment's expected service life. It was preferred to install a 6-mm perforated plate band screen; however, hydraulics and space constraints make this a non-feasible consideration. To improve the system performance without completely revising the influent structure, a traditional multi-rake screen is proposed.

This alternative provides the cost to remove the comminutors, modify the influent channel, and install a new ¼-inch multirake bar screen, shown schematically in Figure 1. Bar screens remove debris from the wastewater and are superior technology to comminutors which merely grind up the debris. The ground up debris from comminutors remain in the system and re-agglomerate in pipes and tanks causing maintenance issues for pumps, digesters and dewatering equipment. The alternative is expected to

remedy the influent channel grit accumulation concerns as the operators can regularly purge the grit with flow to the new screen.

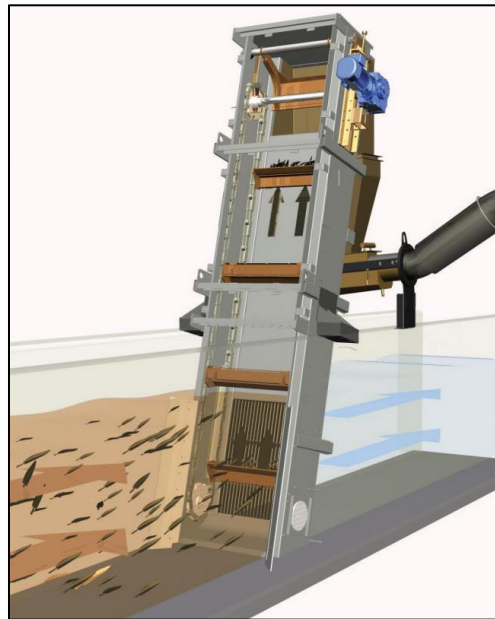


Figure 1 – Multirake Fine Screen

Advantages

- Provides full redundancy for the critical influent screening process
- Improves reliability of backup screening system
- Removes grit accumulation concern in piping between diversion box and comminutors

Disadvantages

- Multi-rake technology is considered a compromise of achieving high screenings capture while minimizing construction cost

Cost

\$1,007,000 initial cost.

H-2 Grit System Programming

Purpose and Description

The grit system needs are related to the current system having a slow reaction time when high flows hit the plant. The proposed alternative solution resolves this by engaging the peak grit capacity sooner, based on high flows observed to be occurring in the collection system.

This alternative provides time and materials to identify the problem, develop strategies, revise the program logic, and travel to the site to verify program functionality.

Advantages

- Low cost project for potential increase in grit system performance.

Disadvantages

- None

Cost

\$6,000 initial cost.

H-3 HVAC Improvements

Purpose and Description

The HVAC systems at the headworks facility are exposed to a corrosive environment and are currently nearing their useful life and are recommended for replacement during the planning period.

Advantages

- Improves air quality to protect equipment from corrosion and maintains operator safety

Disadvantages

- None.

Cost

\$258,000 initial cost.

H-4 Septage Receiving

Purpose and Description

The existing septage and grease receiving system has no monitoring or pretreatment components. This alternative provides construction of a new septage receiving, screening, and control building for the introduction of septage at the plant headworks. This facility is proposed to be located north of the existing headworks facility and would include an external truck connection, fine screen, flowmeter, and a 10,000 gallon holding tank to prevent slugs to the raw wastewater. Flow is metered into the raw wastewater using a submersible pump, but could also be accomplished with a control valve. An example septage station from Grafton, WI is illustrated in Figure 2.

A phased approach towards this system is possible to install the flow management concept in the near term, while a screening system is added in the mid-term.



Figure 2 – Septage Receiving Station

Advantages

- Eliminates rocks, grit, and rags that could damage or overwhelm the main fine screen.
- Provides treatment services for septage produced in the regional area not served by the sewer service area.
- Improves accountability and billing for septage customers
- Enables metering of high strength wastes

Disadvantages

- Location likely congests vehicle traffic/parking in Administration and Headworks area on plant site

Cost

\$1,541,000 initial cost.

Primary Clarification

PC-1 Scum Pit 3 (Scum Pump) with High Strength Waste

Purpose and Description

System needs associated with primary treatment require utilization of Primary Clarifiers No. 1-3 for peak flow capacity. This alternative provides improved scum handling systems to reduce operator demands when these tanks are online. This alternative provides a new scum well near Clarifier No. 3 with a dedicated scum pump allowing the sludge to remain in service for sludge demands. The scum system piping is recommended as glass lined ductile iron to minimize grease plugging concerns.

This alternative involves excavation, concrete construction of a pump room, and sludge piping modifications. The combination of these aligns well with the goal of adding high strength waste (HSW) to the anaerobic digesters. The proposed system was expanded slightly to include a trash rack, grit sump, and segmented tank for special high HSW (i.e., brewery membrane retentate) that are amenable

for co-digestion. The proposed scum pump system would be dual purposed for dosing HSW when not pumping scum.

Advantages

- Reduces or eliminates staff resistance to utilize existing tankage, thus improving peak flow treatment performance.
- Facilitates receipt of external high strength wastes for co-digestion. Revenue from tipping fees and increased biogas production are anticipated.
- Multi-function use of the scum system improves staff awareness of pump and piping system functionality for improved system reliability when required for peak flows.

Disadvantages

- Dosing of high strength waste must be temporarily halted to convey scum.
- Location is not directly adjacent to digestion, which could create concerns with plugging if scum not thoroughly flushed after usage (conveyance of warm HSW may alleviate potential plugging).

Cost

\$623,000 initial cost.

PC-2 High Strength Waste and Septage Receiving at Gravity Thickener No. 1

Purpose and Description

An alternative (or complimentary) option to PC-1's HSW facilities is to provide a larger high strength waste receiving system as the program increases in demand. This alternative provides retrofit improvements to the north gravity thickener (GT) for high strength waste (HSW) receiving. Similar bar rack, grit sump, and odor control cover systems are included to meter HSW into the existing sludge piping to feed the anaerobic digesters. Reuse of the thickener offers pump and piping system savings as sludge conveyance already exists. However, due to the larger tank size and increased diversity of received wastes with this option, a mixing system is included. A corrosion protective coating is included to protect concrete and metallic surfaces from the low pH concerns related to holding high strength

wastes. Existing piping and pumping systems need to be verified for low pH material handling compatibility. An example HSW facility at Stevens Point, WI is depicted in Figure 3.



Figure 3 – High Strength Waste Receiving

Advantages

- High volume and wide range of acceptance for HSW. Revenue from tipping fees and increased biogas production are anticipated.
- Repurposes (potentially) unused tankage

Disadvantages

- Requires thickening system improvements to minimize tankage costs.

Cost

\$490,000 initial cost.

Activated Sludge

AS-1 Activated Sludge Reactor Splitter Box

Purpose and Description

The existing primary effluent is divided to both activated sludge reactor trains using piping and valves, which does not provide a uniform flow split at all conditions. This alternative provides an upflow splitter box with overflow weirs to evenly divide the flow to each activated sludge reactor train. The proposed splitter box divides the flows and then reuses existing piping to convey the flow to the anaerobic zones.

Advantages

- Improved flow split to the two parallel trains at minimum, average, and peak flows.
- Increased treatment performance through the unaerated and aerated zones, due to reduced short circuiting from flow imbalances

- Increased aeration efficiency resulting from comparable oxygen demand between the dual aeration train zones served by the same aeration header control valve.

Disadvantages

- Increased headloss; however, primary effluent is pumped prior to this splitter box and headloss increase is anticipated to have negligible impact on pump performance or primary effluent conveyance capacity.

Cost

\$353,000 initial cost.

AS-2 Large Blade Submersible Selector Mixers

Purpose and Description

The selector zone mixers are anticipated to require replacement during the planning period to improve reliability. A brief review of available replacement mixing systems was discussed; however, the continued use of submersible mixing technology is recommended as it can be performed at the lowest cost. A recent facility energy survey identified the selector zone mixers to exceed current industry standards for mixing in biological phosphorus removal selector zones. This alternative provides replacement of the current high speed submersible mixers with large blade low speed submersible mixers in the same location. An example of this type of mixer is presented in Figure 4. Although the current mixers are operated in an on/off mode, the proposed mixers are significantly lower horsepower, resulting in energy savings. Aside from the economic benefits, reduced mixing may also improve the performance of the unaerated selector through reduced air entrainment from surface vortexing. The proposed system was selected to run continuously; however, upon startup, a similar on/off operating strategy may be continued if filamentous conditions can be avoided.

Note, the implementation of the unaerated selector volume included conversion to the Modified University of Cape Town (MUCT) biological nutrient removal process (see AS-3) as the City indicated mixing systems would most likely not be converted until a major process change.



Figure 4 – Low Speed Submersible Mixer

Advantages

- Lower energy demand
- Fewer mixers for operation and maintenance
- Provides replacement mixers extending the system's useful life
- Utilizes existing electrical and control infrastructure
- Staff familiarity in mixing system

Disadvantages

- Requires installation of new tripod stands for mixers
- Mixing system maintenance components require mixer to be removed from service

Cost

\$355,000 initial cost. Proposed annual energy savings of \$23,000 would provide a 15 year simple payback.

AS-3 Modified University of Cape Town

Purpose and Description

The existing Anoxic/Anaerobic/Oxic (A2O) process was identified as inefficient and the anoxic/anaerobic portions consume a large portion (50%) of the existing bioreactor volume, thus limiting the aerobic volume/sludge retention time (SRT) for nitrification. This alternative provides improvements to convert the two trains into the Modified University of Cape Town (MUCT) process. The MUCT process conversion was simulated using Biowin® process modeling to demonstrate equivalent phosphorus treatment performance with improved ammonia treatment performance.

This alternative provides modifications to the existing activated sludge tanks by revising the location of and return activated sludge. The existing mixed liquor recycle pumps will be adapted for returning denitrified mixed liquor to the front of the anaerobic zones. The first pass of each activated sludge bioreactor will comprise the anaerobic and anoxic zones (33% of the total bioreactor volume,) and the second and third passes will be fully aerobic which will increase aerobic SRT and nitrification performance at any given MLSS concentration. The proposed unaerated selector zone configuration is illustrated in Figure 5.

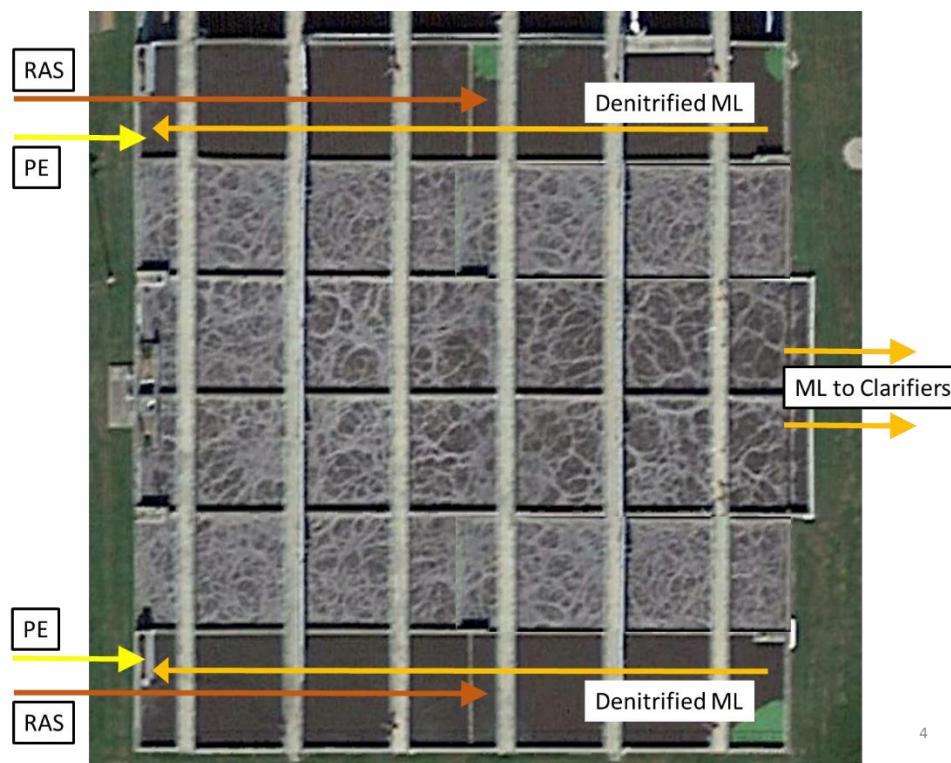


Figure 5 – MUCT Layout

Advantages

- Improved carbon efficiency for phosphorus removal
- Improved nitrification with a lower total SRT to minimize filamentous bacteria
- Decreased interference from recycled nitrate

Disadvantages

- Reduced anaerobic volume

Cost

\$1,089,000 initial cost. Proposed aeration control improvements result in annual energy savings of \$22,865.

AS-4 Secondary Clarifier Splitter Box

Purpose and Description

This alternative replaces the existing secondary clarifier splitter with a new structure which will be sized to slow the mixed liquor and use weirs to more equally split the flow. The proposed system includes 36"

pipng to connect to existing mixed liquor piping that feeds each clarifier. An example splitter box is depicted in Figure 6.



Figure 6 – Splitter Box Example

Advantages

- Reliable flow split for increased clarifier performance under all flow and maintenance conditions

Disadvantages

- Challenging construction sequencing

Cost

\$936,000 initial cost.

AS-5a New Submersible Return Activated Sludge Pump Stations

Purpose and Description

The current return activated sludge (RAS) pumping system provides central RAS collection and pumping. Although this is efficient, it does not provide ideal flexibility for operations and maintenance. The existing suction lines are long and not capable of being isolated to clear settled debris or monitor pipe integrity.

This alternative provides four new manhole pump stations, one at each clarifier, to capture the RAS and pump it back to the Plant 2 Building using adjustable speed submersible pumps (one per manhole). An on the shelf spare RAS pump would be kept available for quick replacement in any of the four pump stations. Existing piping will be reused where possible after adding a valves and flow metering for each pump. It is possible that the pump station for Clarifier No. 2 and 4. could be combined into one structure.

Advantages

- Flow monitoring and control of individual clarifiers
- Replacement of existing RAS pumping equipment

Disadvantages

- Submersible pumps
- On shelf redundancy

Cost

\$1,168,000 initial cost.

AS-5b Modify Return Activated Sludge Piping to Minimize Deposition

Purpose and Description

The current return activated sludge (RAS) pumping system provides central RAS collection and pumping. Although this is efficient, it does not provide ideal flexibility for operations and maintenance. The existing suction lines are long and not capable of being isolated to clear settled debris or monitor pipe integrity.

This alternative provides a new buried plug valve on the RAS suction line of each clarifier. The intent is to enable staff the flexibility to isolate clarifiers and develop a scouring velocity for removal of any blockages that may occur in the lines by closing the suction lines for the other clarifiers in service. This will allow for the continued use of existing equipment and infrastructure.

Since this alternative does not provide the ability to monitor or control the active rate of sludge withdrawal, this alternative requires use of AS-4 to provide a uniform sludge loading to each clarifier.

Advantages

- Minimal cost
- Increased operator flexibility and troubleshooting
- Continued use of existing RAS system

Disadvantages

- No flow monitoring or control of individual clarifiers.

Cost

\$224,000 initial cost.

AS-6 Secondary Clarifier FEDWA Inlets and Rapid Sludge Withdrawal

Purpose and Description

The existing clarifier mechanisms were recently refurbished and are adequate for current and future needs. However, replacement mechanisms should be anticipated during the planning period. This alternative provides replacement of the current sludge withdrawal mechanism with an updated style of

the flocculating energy dissipating well arrangement (FEDWA) and rapid sludge withdrawal system to increase settling performance. The center-well inlet baffling FEDWA is shown in Figure 7.



Figure 7 – FEDWA Clarifier Inlet

Advantages

- Improved flocculation for increased flow capacity
- Enhanced sludge removal and prevention of sludge blanket disturbance.

Disadvantages

- None

Cost

\$1,600,000 initial cost.

AS-7 Secondary Clarifier Density Current Baffles

Purpose and Description

The existing clarifiers utilize center feed and peripheral overflow weirs, this arrangement has been documented to develop density currents that lead to short circuiting, thus limiting performance. This alternative provides the addition of density current baffles to redirect the velocities inside the tank and prevent short circuiting of mixed liquor to the effluent. Figure 8 illustrates the before and after with solids being carried up and over the weirs or re-directed to the centerwell with and without baffling.

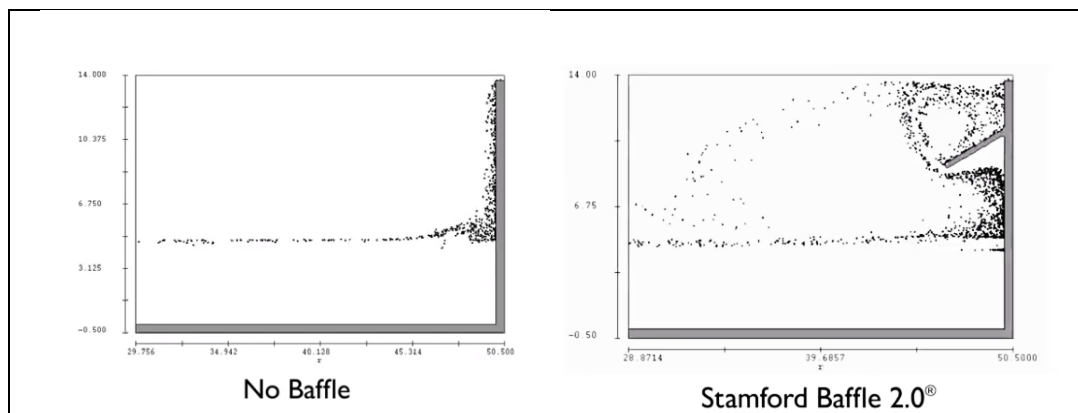


Figure 8 – Density Currents with and without Baffles

Advantages

- Improves clarifier capacity
- Improves secondary effluent quality

Disadvantages

- None

Cost

\$315,000 initial cost.

Effluent Phosphorus Treatment

As identified in the City's Preliminary Compliance Alternatives Plan (PCAP), attached for reference as Appendix B, regulatory compliance with a future 0.1 mg/L TP limit is recommended to occur as a tertiary treatment process. The proposed limit is based on a seasonal 6-month average, which enables the facility to right-size the new effluent filters to meet effluent requirements using available tankage to minimize capital costs. The PCAP identified the minimum firm capacity required as 16 MGD for full tertiary capacity, where peak secondary effluent flows in excess of this capacity overtop a weir and recombine with filtered effluent prior to discharge and provide reliable compliance with the monthly and 6-month limits. This intentional blending does not compromise the health and human safety of the receiving water, as all flows will receive full disinfection.

Alternatives EP-1a, EP-1b, and EP-1c provide effluent pumping, chemical addition, and filtration. The three alternatives represent the three most cost effective phosphorus precipitation and solids separation techniques for low level phosphorus removal filters on the market at this time.

EP-1a Inside-Out Cloth Disk Filter with Coagulation Zones

Purpose and Description

This alternative provides a new cloth media inside-outside disk filtration system. This system consists of three units, with a firm capacity of roughly 16 MGD and one redundant unit. The existing chlorine contact tank will be converted for tertiary phosphorus removal. A wet well with pumps will lift the secondary effluent into the tertiary system's rapid mix tank where coagulant (i.e., ferric chloride) will be mixed at a G-Factor of over 500 sec⁻¹ to provide contact time for the chemical to bind with reactive phosphorus. Following precipitation, the coagulation and flocculation zones add a small dose of polymer to develop larger floc particles for efficient filtration. The inside-out filter units utilize a rotating drum of synthetic cloth filter mesh (10 or 5 micron openings) to capture the solids and allow filtered water to exit the unit. A backwash spray cleans the cloth media and is recycled to the WWTP drain, which is

anticipated at <3% of forward flow. Figure 9 shows a newly installed disk filter system at Medford, WI for low-level phosphorus removal.



Figure 9 – Inside-Out Cloth Disk Filter Schematic

Advantages

- Lowest total cost option
- Lowest footprint
- Backwash pump access from above unit

Disadvantages

- High chemical costs
- Few local installations with limits at or below 0.1 mg/L TP (however local pilot testing proved feasible to support full scale installations for low-level TP elsewhere in the country)

Cost

\$6,871,000 initial cost, and an additional annual cost of \$329,000. The resultant 20-year total present worth is \$11,495,000.

EP-1b Outside-In Cloth Disk Filter with Coagulation Zones

Purpose and Description

This alternative provides a new cloth media outside-in disk filtration system. This system consists of three units, with a firm capacity of roughly 16 MGD and one redundant unit. The existing chlorine contact tank will be converted for tertiary phosphorus removal. A wet well with pumps will lift the secondary effluent into the tertiary system's rapid mix tank where coagulant (i.e., ferric chloride) will be mixed at a G-Factor of over 500 sec^{-1} to provide contact time for the chemical to bind with reactive phosphorus. Following precipitation, a flocculation zone adds a small dose of polymer to develop larger floc particles for efficient filtration. The filter units utilize a rotating drum of synthetic deep-pile cloth filter mesh to capture the solids and allow filtered water to exit the unit. A backwash suction header

cleans the cloth media and is recycled to the WWTP drain, which is anticipated at <3% of forward flow. Figure 10 provides a schematic of this style of disk filtration.

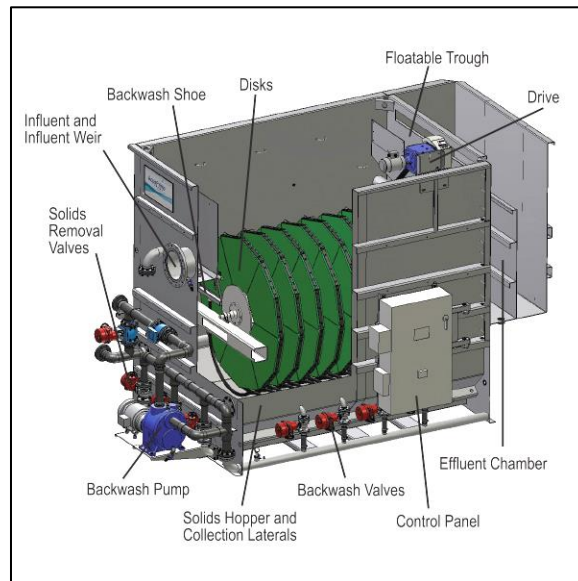


Figure 10 – Outside-In Cloth Disk Filter Schematic

Advantages

- Lowest initial cost option
- Low footprint

Disadvantages

- Requires dry-pit area for backwash pumps
- High chemical costs
- Few local installations with limits at or below 0.1 mg/L TP (however local pilot testing proved feasible to support full scale installations for low-level TP elsewhere in the country)

Cost

\$5,617,000 initial cost, and an additional annual cost of \$424,000. The resultant 20-year total present worth is \$11,576,000.

EP-1c Reactive Upflow Sand Filter with Coagulation Zones

Purpose and Description

This alternative provides a new reactive upflow sand filtration system. This system consists of 16 separate cells/units functioning in parallel, with a firm capacity of roughly 16 MGD and one redundant unit. The existing chlorine contact tank will be converted for tertiary phosphorus removal. A wet well with pumps will pump the secondary effluent into the base of the tertiary system. The filter system consists of a ferric chloride impregnated sand for phosphorus precipitation. No additional polymer or mixing zones are required. As the flow works its way up the sand filter bed, soluble phosphorus reacts with the sand, precipitates, and is captured in the sand. An air lift pump withdraws the reacted sand

and captured particles as a backwash. Since applied phosphorus is expected to be under 0.6 mg/L TP, only a single stage filter is required. Figure 11 provides a schematic of this style sand filtration.

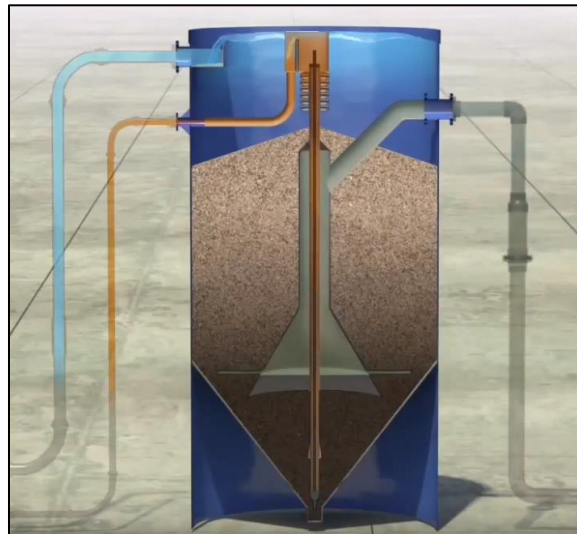


Figure 11 – Upflow Sand Filter Schematic

Advantages

- Highest initial cost option
- Largest footprint, but within existing tankage
- Regional installations
- Minimal control points

Disadvantages

- Multiple filter cells
- Highest headloss

Cost

\$9,052,000 initial cost, and an additional annual cost of \$269,000. The resultant 20-year total present worth is \$12,833,000.

EP-2 Secondary Clarifier Launder Covers

Purpose and Description

The City's existing secondary clarifiers develop significant algae growth at the weirs and launders. To decrease maintenance towards algae control and improve the respective solids (pieces of algae) loading applied to the filters – a peripheral launder cover is recommended to shade the channels from sunlight.

This alternative provides fiberglass launder covers with magnetic clasps for each of the four secondary clarifiers. The covers shield sunlight and prevent the proliferation of algae on submerged surfaces. The panels are able to be tipped upwards for general observation or maintenance, as shown in Figure 12.



Figure 12 – Clarifier Launder Cover

Advantages

- No impact to tank construction or operation
- Limit algae growth for increased filter performance

Disadvantages

- Covered weirs prevent quick operator observations of tank performance

Cost

\$627,000 initial cost.

Disinfection

DI-1 Replacement of Ultra-Violet System

Purpose and Description

The existing ultraviolet (UV) light disinfection system functions as required for current and future system needs; however, reliability of parts inventory may be a concern as the system reaches the end of its useful life. A replacement system was identified to budget for full system replacement during the planning period. Figure 13 illustrates a similar in-channel UV disinfection system that is proposed.

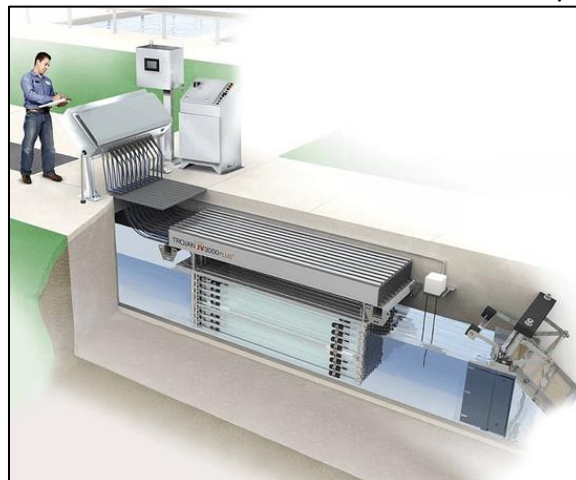


Figure 13 – Ultraviolet Disinfection System

Advantages

- Reduced hydraulic headloss with horizontal lamp system
- Ability to utilize non-proprietary bulbs
- Many local installations

Disadvantages

- None.

Cost

\$1,919,000 initial cost.

Sludge Thickening

The facility is currently capacity limited by how much sludge volume can be processed through the anaerobic digesters. The projected flows and loadings would result in an anaerobic digestion hydraulic retention time (HRT) of 12.5 days if no improvements are enacted. This falls short of both the Wisconsin NR110 code required minimum of 15 days HRT, and the industry standard 20 day HRT. Two main improvements may resolve this: decrease the flow/hydraulic loading to the digesters (i.e., improve raw sludge thickening) or increase the anaerobic digestion reaction rates (i.e., operate at higher temperatures). The following alternatives provide varying techniques to accomplish sludge thickening prior to digestion.

ST-1a Combined Raw Sludge Disk Thickening

Purpose and Description

This project is for the thickening of both primary and waste activated sludge on a new raw sludge inclined disk thickening system. However, after reviewing the technology and the required flow rates, this application was disregarded as the manufacturer would require additional units and recommended against this application.

Advantages

- Not applicable.

Disadvantages

- Not applicable.

Cost

Not applicable.

ST-1b Separate Waste Activated Sludge Disk Thickening and Struvite Control

Purpose and Description

This alternative provides mechanical thickening of waste activated sludge (WAS) across a dual-unit disk thickener located in the thickener room. An example installation from Springfield, IL is shown in Figure 14. The existing gravity belt thickener (GBT) used for thickening digested sludge is plumbed for processing WAS, and will serve as a redundant unit. Likewise, the new WAS thickening device could serve as a redundant unit for digested sludge thickening. The thickening system is sized for continuous operation, monitored remotely by camera similar to the digested sludge GBT. The new thickener system

utilizes the WAS pumps in Plant 2 to feed the unit, a new emulsion polymer makedown/feed system, and a new thickened sludge pump to convey thickened WAS (TWAS) to the digesters. The disk thickener system would be expected to achieve a TWAS concentration of 5-6% total solids (TS) concentration, which will cut the WAS flow to digestion by approximately 50%.

With mechanical thickening of WAS, the primary sludge will continue to be thickened alone in the gravity thickener. The City trialed this and observed approximately 4% TS thickened primary sludge was achievable, which reduces the primary sludge flow to digestion by approximately 30%.

The combined impact of this thickening approach yields a future average anaerobic digestion HRT of 18 days.

By separating the contact time of WAS and primary sludge pre-digestion, less phosphorus release is expected and additional struvite concerns are anticipated, particularly on the filtrate after GBT thickening of the digested sludge. Therefore, this option includes an allowance for an additional maintenance dose of ferric chloride to the GBT filtrate to tie-up soluble phosphorus and minimize struvite potential.



Figure 14 – Disk Thickener Example

Advantages

- Low initial cost.
- Low annual cost.

Disadvantages

- Potential digestion stability near threshold HRT
- Ferric chloride costs

Cost

\$883,000 initial cost, and an additional annual cost of \$38,000. The resultant 20-year total present worth is \$1,418,000.

ST-1c Combined Raw Sludge Gravity Belt Thickening

Purpose and Description

This alternative provides mechanical thickening of both primary sludge and WAS across a 2-meter gravity belt thickener located in the thickener room. The basic schematic of a GBT is provided in Figure 15. The existing gravity belt thickener (GBT) used for thickening digested sludge is plumbed for processing primary sludge and/or WAS, and will serve as a redundant unit. Likewise, the new WAS thickening device could serve as a redundant unit for digested sludge thickening. The thickening system is sized for continuous operation, monitored remotely by camera similar to the digested sludge GBT. The new thickener system utilizes the sludge pumps in Plant 2 to feed the unit, new emulsion polymer make-down, and a new thickened sludge pump to convey thickened raw sludge to the digesters. The City trialed this arrangement with the existing GBT and expects to achieve 7% TS concentration, which will cut the thickened sludge flow to digestion by approximately 60%. Other facilities have observed 9% TS output, once optimized.

The impact of this thickening approach yields a future average anaerobic digestion HRT of 23 days.

By maintaining the contact time of WAS and Primary Sludge pre-digestion in a single gravity thickener as well as across the thickener, a similar amount of phosphorus release is expected, thus not increasing concerns for struvite.

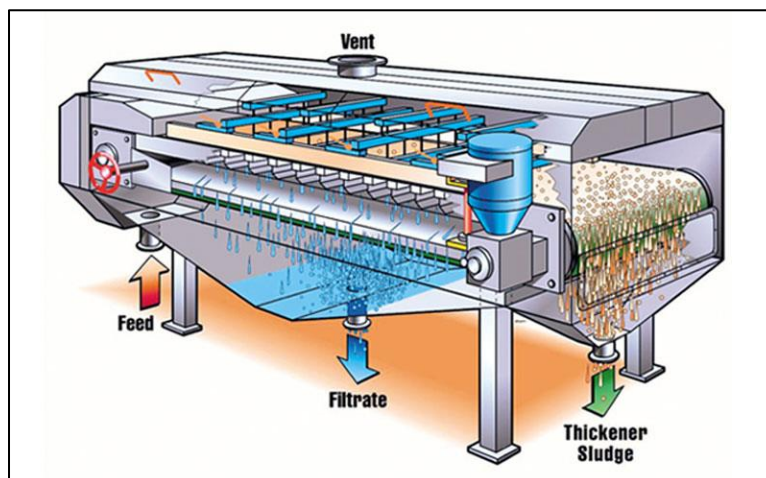


Figure 15 – Gravity Belt Thickener Schematic

Advantages

- Low initial cost. No capital cost change to switch to Alt ST-1d for reduced operational expenses.
- Increased digestion stability
- Minimizes heating demand at digestion
- Blended sludge to the thickener enhances performance

Disadvantages

- Increased polymer cost due to treating all sludge flows
- Higher solids concentration in digesters for mixing

Cost

\$858,000 initial cost, and an additional annual cost of \$48,000. The resultant 20-year total present worth is \$1,533,000.

ST-1d Separate Waste Activated Sludge Gravity Belt Thickening and Struvite Control

Purpose and Description

This alternative provides mechanical thickening of WAS across a 2-meter gravity belt thickener located in the thickener room. The existing gravity belt thickener (GBT) used for thickening digested sludge is plumbed for processing WAS, and will serve as a redundant unit. Likewise, the new WAS thickening device could serve as a redundant unit for digested sludge thickening. The thickening system is sized for continuous operation, monitored remotely by camera similar to the digested sludge GBT. The new thickener system utilizes a sludge pump in Plant 2 to feed the unit, new emulsion polymer make-down, and a new thickened sludge pump to convey TWAS to the digesters. The GBT system on WAS only is expected to achieve 6% TS concentration, which will cut the WAS flow to digestion by approximately 50%.

With mechanical thickening of WAS, the primary sludge will continue to be thickened alone in the gravity thickener. The City trialed this and observed approximately 4% TS thickened primary sludge was achievable, which reduces the primary sludge flow to digestion by approximately 30%. An example of rotary drum thickened WAS is pictured in Figure 16.

The combined impact of this thickening approach yields a future average anaerobic digestion HRT of 18 days.

By separating the contact time of WAS and Primary Sludge pre-digestion, less phosphorus release is expected and additional struvite concerns are anticipated. Therefore, this option includes an additional maintenance dose of ferric chloride.

Advantages

- Low initial cost. No capital cost change to operate in combined mode; however, capacity is limiting.
- Lowest annual cost
- Familiar unit process for automation

Disadvantages

- Potential digestion stability near threshold HRT
- Ferric chloride costs

Cost

\$648,000 initial cost, and an additional annual cost of \$37,000. The resultant 20-year total present worth is \$1,168,000.

ST-1e Combined Raw Sludge Rotary Drum Thickening

Purpose and Description

This alternative provides mechanical thickening of both primary sludge and WAS across two rotary drum thickeners (RDTs) located in the thickener room. The existing gravity belt thickener (GBT) used for thickening digested sludge is plumbed for processing primary sludge and/or WAS, and will serve as a redundant unit. Likewise, the new WAS thickening devices could serve as a redundant unit for digested sludge thickening. The thickening system is sized for continuous operation, monitored remotely by camera similar to the digested sludge GBT. The new thickener system utilizes new sludge pumps in Plant 2 to feed the units, new emulsion polymer make-down systems, and a new thickened sludge pump to push material to the digesters. Performance is anticipated to match the GBT concentrations, but at up to twice the polymer dose, thus the system should achieve 7% TS concentration, which will cut the thickened sludge flow to digestion by approximately 60%.

The impact of this thickening approach yields a future average anaerobic digestion HRT of 23 days.

By maintaining the contact time of WAS and primary sludge pre-digestion in a single gravity thickener as well as across the thickener, a similar amount of phosphorus release is expected, thus not increasing concerns for struvite.



Figure 16 – Rotary Drum Thickener Example

Advantages

- Sludge thickening upsets are contained
- Increased digestion stability
- Minimizes heating demand at digestion
- Blended sludge to the thickener enhances performance

Disadvantages

- Highest initial cost
- Highest annual cost

- Higher solids concentration in digesters for mixing
- Staff familiarity with RDT operation and ability to monitor visually with camera

Cost

\$1,646,000 initial cost, and an additional annual cost of \$151,000. The resultant 20-year total present worth is \$3,679,000.

ST-1f Separate Waste Activated Sludge Rotary Drum Thickening and Struvite Control

Purpose and Description

This alternative provides mechanical thickening of WAS across a rotary drum thickener (RDT) located in the thickener room. The existing gravity belt thickener (GBT) used for thickening digested sludge is plumbed for processing WAS, and will serve as a redundant unit. Likewise, the new WAS thickening device could serve as a redundant unit for digested sludge thickening. The thickening system is sized for continuous operation, monitored remotely by camera similar to the digested sludge GBT. The new thickener system utilizes a sludge pump in Plant 2 to feed the unit, new emulsion polymer make-down, and a new thickened sludge pump to push material to the digesters. Performance is anticipated to match the GBT concentrations, but at up to twice the polymer dose, thus the system should achieve 6% TS concentration, which will cut the WAS flow to digestion by approximately 50%.

With mechanical thickening of WAS, the primary sludge will continue to be thickened alone in the gravity thickener. The City trialed this and observed approximately 4% TS thickened primary sludge was achievable, which reduces the primary sludge flow to digestion by approximately 30%.

The combined impact of this thickening approach yields a future average anaerobic digestion HRT of 18 days.

By separating the contact time of WAS and primary sludge pre-digestion, less phosphorus release is expected and additional struvite concerns are anticipated. Therefore, this option includes an additional maintenance dose of ferric chloride.

Advantages

- Simple and enclosed operation

Disadvantages

- Not amenable to operating in a combined thickening mode
- Potential digestion stability near threshold HRT
- Ferric chloride costs

Cost

\$940,000 initial cost, and an additional annual cost of \$60,000. The resultant 20-year total present worth is \$1,784,000.

Digester Operation, Heating, and Recirculation

As identified in the previous section, the facility is currently capacity limited by anaerobic digester HRT. The projected flows and loadings would result in an anaerobic digestion HRT of 12.5 days if no improvements are enacted, while Wisconsin's NR110 code requires a minimum of 15 days HRT for mesophilic digestion. The previous section examined options to decrease hydraulic loading on digestion

through improved raw sludge thickening. The following alternatives provide varying techniques to accomplish higher-rate digestion.

Typical industry standards for detention time in mesophilic digestion, allow for a 15 to 20 days HRT for stable digestion in a well heated and mixed reactor. Thermophilic reactors often allow for 5 days HRT, but are followed by a 10 day mesophilic to reduce odors, improve gas characteristics, and solids dewatering. The proposed thickening concepts in the previous section enable the projected sludge loadings to satisfy either of these conditions, and a better understanding of operation at max month conditions should be verified to confirm facility tolerance to the minimum HRT for reliable operation.

D-1 Status Quo (Mesophilic, Parallel Feed, Replace Pumps and Heat Exchangers In Kind)

Purpose and Description

This alternative provides a continuation of the current mesophilic anaerobic digestion system. Based on the HRT summary above, this alternative requires sludge thickening improvements to meet code capacity requirements. The costs for sludge thickening are not included herein, but rather the costs within this status quo alternative provide renovation and replacement of equipment at the anaerobic digestion complex. New mixing systems are required under Alternative DM-1 below.

Proposed system improvements include: new dual fuel (biogas and natural gas) boilers, heat exchangers and sludge recirculation pumps and a hot water loop system to share heat between systems, which would also be amenable to heat recovery from a cogeneration system. New structures are required for NFPA 820 compliance, improving suction head on the recirculation pumps, and providing space for the boilers. Estimated average heating demand is 1.7M BTU/hr, 3M BTU/hr peak.

The proposed flow scheme is illustrated in Figure 17. To improve the City's timeframe on when to decide if liquid or cake biosolids should be produced, a post-digester liquid storage buffer tank of 0.7 million gallons was included. This tankage will prevent the City from making cake biosolids from the thickened liquid storage tanks, which limits performance and requires higher operating costs.

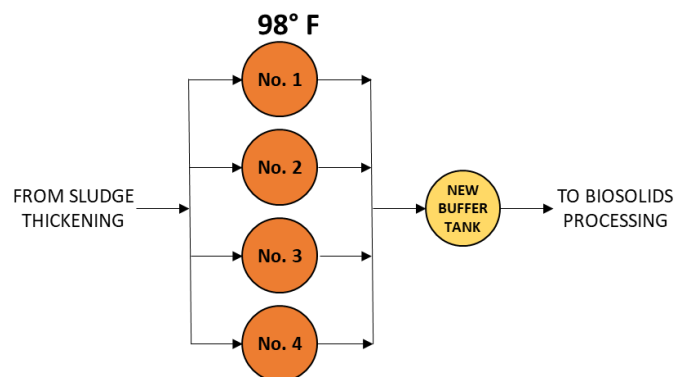


Figure 17 – Mesophilic Digestion Flow Schematic

Advantages

- Familiar unit process operation and control, and biosolids products
- Less sensitive mesophilic temperatures

Disadvantages

- Lower rate system limits total system capacity
- Requires all digesters and high rate thickening to reach goal HRT of over 20 days
- Digested sludge buffer tank consumes WWTP footprint

Cost

\$3,486,000 initial cost.

D-2 Temperature Phased Anaerobic Digestion (TPAD) Conversion

Purpose and Description

This alternative provides a higher temperature thermophilic anaerobic digestion system followed by mesophilic often termed temperature phased anaerobic digestion (TPAD). The proposed system is a continuous flow through process, not intended to directly meet the Class A requirements which would require the thermophilic phase be conducted in batches. This alternative maintain digestion stability and performance at higher rates. Although thermophilic systems can be operated at lower HRTs, a minimum of 15 days total is still recommended to maintain high quality methane production and fully stabilized biosolids. Given the higher heating demand with a thermophilic system, sludge thickening is recommended. The costs for sludge thickening are not included herein, but rather the costs within this thermophilic alternative provide renovation and upgraded of equipment at the anaerobic digestion complex. New mixing systems are required under Alternative DM-1 below.

Proposed system improvements include: new dual fuel (biogas and natural gas) boilers, heat exchangers and sludge recirculation pumps and a hot water loop system to share heat between systems, which would also be amenable to heat recovery from a cogeneration system. A sludge cooling heat exchanger is also included to rapidly drop the sludge temperature from 131°F to 98°F and preheat feed sludge. New structures are required for NFPA 820 compliance, improving suction head on the recirculation pumps, and providing space for the boilers. Estimated average heating demand is 3.1M BTU/hr, 5M BTU/hr peak.

The proposed flow scheme is illustrated in Figure 18. Since the TPAD digestion system can operate with reduced detention times compared to mesophilic digestion, operation at roughly 75% of the HRT of a mesophilic system, the fourth digester could be multi-purposed as the post-digester liquid storage buffer tank prior to solids thickening/dewatering.

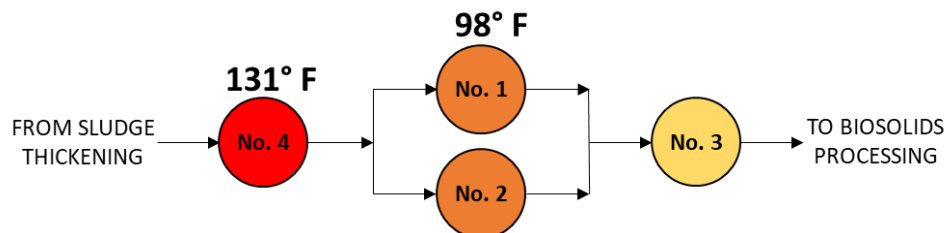


Figure 18 – TPAD Schematic

Advantages

- Lower cost due to eliminated tankage
- Smaller footprint

- Increased capacity for future growth or acceptance of high strength wastes
- Potential for increased volatile solids destruction
- Flexibility for future conversion to batch mode for Class A liquid biosolids

Disadvantages

- Non-familiar system
- Potentially increased carbon dioxide content in biogas
- Potential for odorous biosolids if problems or insufficient mesophilic digestion polishing occurs

Cost

\$2,962,000 initial cost. Operational costs are anticipated to be slightly higher than Alternative D-1 due to the higher heating losses at elevated temperatures; however, with heat recovery systems and improved gas production, additional natural gas is not anticipated.

D-3 Waste Activated Sludge Pre-Digestion Conditioning (Temperature and pH)

Purpose and Description

This alternative provides a high temperature and high pH environment to accelerate the decomposition of the difficult to digest cell membranes of the waste activated sludge. Often termed a thermal chemical hydrolysis (TCH) process, the most cost effective versions use higher temperatures (150°F) and dose sodium hydroxide to elevate the pH. The hydrolysis reactor has been demonstrated to increase the digestibility of the WAS, thus increasing gas production and decreasing solids for disposal.

The proposed system is a continuous flow through process, not intended to directly meet the Class A requirements as only WAS is pre-treated. The reactor would be located in the Dewatering Building to minimize new structures. Although the preconditioned system is more digestible, a minimum of 15 days total is still recommended to maintain high quality methane production and fully stabilized biosolids.

Given the higher heating demand to support the preconditioning reactor, WAS thickening improvements are required, but excluded from this alternative. New mixing systems are required under Alternative DM-1 below.

Proposed system improvements include: new dual fuel (biogas and natural gas) boilers, heat exchangers and sludge recirculation pumps and a hot water loop system to share heat between systems, which would also be amenable to heat recovery from a cogeneration system. New structures are required for NFPA 820 compliance, improving suction head on the recirculation pumps, and providing space for the boilers. Also included is a TCH vendor package consisting of: hydrolysis reactor, sodium hydroxide storage and dosing system, dedicated heat exchanger for the high-temperature reactor, recirculation pump, controls and commissioning assistance.

The proposed flow scheme is illustrated in Figure 19Figure 17. Since the TCH system can operate with reduced detention times compared to traditional mesophilic digestion, operation at roughly 75% of the HRT of a traditional mesophilic system, the fourth digester could be multi-purposed as the post-digester liquid storage buffer tank prior to solids thickening/dewatering.

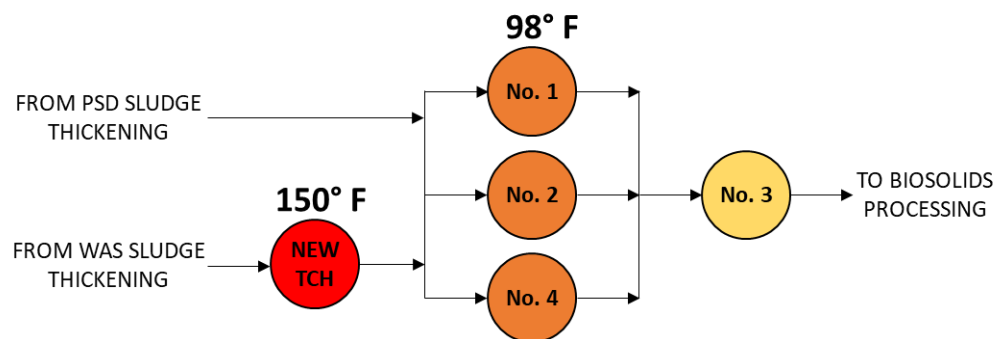


Figure 19 – WAS Pre-Conditioning Example

Advantages

- Increased volatile solids destruction
- Lower cost due to eliminated tankage
- Smaller footprint

Disadvantages

- Increased complexity
- Vulnerability to capacity issues during system maintenance
- Non-familiar system
- Increased chemical costs and handling

Cost

\$5,653,000 initial cost, and an additional annual cost of \$25,000. The resultant 20-year total present worth is \$6,005,000.

Digester Mixing

DM-1 Digester Mixing with Draft Tube & Jet Mixing

Purpose and Description

The City's existing digesters are unmixed, aside from agitation provided by feed and withdrawal, heating system recirculation pumping, and rising biogas bubbles. This level of mixing is not sufficient for high-rate digestion systems with thicker, more viscous sludge. Mechanical mixing was recommended in 2008, and the City has been working towards a plan to implement digester mixing at each of the tanks. As each tank was taken offline for cover repairs and cleaning, new piping penetrations were added to accommodate a pump and nozzle (jet mixing) system in Digesters No. 4, and Digester No. 1 (scheduled to occur in 2019). Digesters No. 1 and No. 4 are situated higher out of the ground, which makes these tanks more amenable to draft tube installation; however, tank 4 has a gas holding side skirt. Schematics of the two types of mixing systems are provided in Figure 20. The City indicated low cost crane services, which enhance service on a draft tube system.

This alternative provides a 30 HP jet mixing systems on the two smaller tanks, operated on VFD to minimize foaming and enable energy savings. Dual 10 HP draft tubes are provided for the two larger tanks. These mixing systems will be tuned upon startup to minimize energy use.

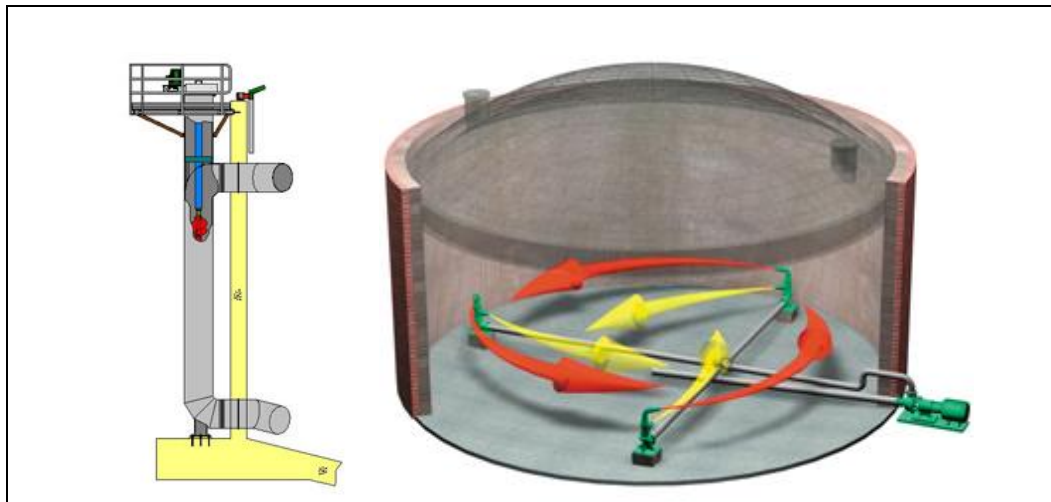


Figure 20 – Digester Mixing Systems (Left: Draft Tube and Right: Jet Mixing)

Advantages

- Increased digester active volume resulting in reliable and efficient digestion
- Allows for high-rate digestion

Disadvantages

- Increased energy cost

Cost

\$1,637,000 initial cost, and an additional annual cost of up to \$60,000. The resultant 20-year total present worth is \$2,481,000.

Biosolids Reuse

The City's current biosolids reuse program has restricted reuse options, as it is a Class B biosolids. The two methods of disposal include agricultural liquid and cake fertilizer and landfilling of cake biosolids. Landfilling is only utilized when all other options have been exhausted. The goals of the following Biosolids Reuse Alternatives are to provide increased storage (up to 330 days), reduce disposal costs, and provide additional pathways for biosolids reuse.

BR-1a Status Quo (80% Liquid 20% Cake to Land Application)

Purpose and Description

This alternative provides a baseline of expected capital and operating costs to provide expanded biosolids storage at a similar proportion of biosolids reuse as primarily liquid, with cake used to supplement when applicable. Liquid biosolids was noted in earlier project workshops to be preferential to most landowners; however, some land types may only be permitted for the application of cake biosolids.

The proposed improvements provide an additional four liquid biosolids storage tanks, and almost 150,000 cf of additional cake biosolids storage. Example storage tanks are pictured in Figure 21. These

improvements, combined with the existing facilities, provide of 330 days total biosolids storage to facilitate annual biosolids land application if weather conditions prevent semi-annual land application.

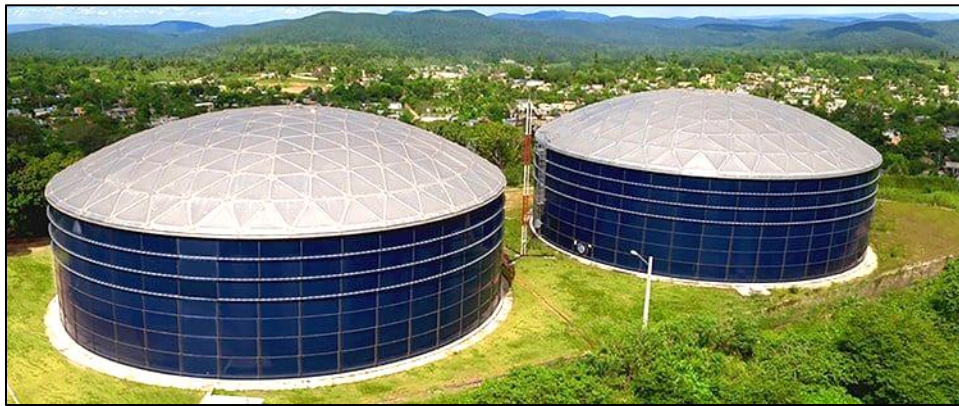


Figure 21 – Liquid Biosolids Storage Tanks

Advantages

- Annual land application ability
- Continued operation familiar to plant staff
- No change to mechanical equipment
- Amenable to phased installation

Disadvantages

- Retains similar land application reliance on weather
- Not Class A biosolids
- Footprint
- Truck traffic
- Hauling costs

Cost

\$11,175,000 initial cost, and annual costs of up to \$1,093,000, which includes final disposal. Note, this is the projected case of the costs that the WWTF is currently paying. The resultant 20-year total present worth is \$26,535,000.

BR-1b 15% Total Solids Liquid Handling (75% Liquid 25% Cake to Land Application)

Purpose and Description

This alternative provides a thermal hydrolysis cell lysis conditioning system on digested sludge to create a liquid/flowable 14-15% TS to significantly increase the storage available, up to 75%, within the existing 12 million gallons of liquid storage. The resulting thickened biosolids are the concentration of a cake biosolids, yet due to cell hydrolysis remain pumpable. The remainder of the 330 day sludge storage is provided within an expanded cake storage facility.

The proposed process utilizes the existing belt press to dewater biosolids directly from digestion. Since the current press achieves 20% TS, a decrease in polymer (or increased hydraulic loading) is expected to de-tune the dewatering to avoid producing cake above the 15% TS goal of a TCH system; higher solids

may exceed the system's mixing and pumping ability. The solids are held in a hopper, prior to being pumped to a batch reactor where low-pressure steam is used to increase temperatures to 167°F (75°C) for 1 hour. High speed shear mixing is used to blend the heated slurry with alkali (typically potassium hydroxide, KOH) to a pH of 9.5. An example thermal hydrolysis system is pictured in Figure 22. The typical KOH feed is 240-280 lb/dT. The system has potential to operate in a recirculation mode, where the lysed biosolids are used to return to digestion for more biogas production, or to the liquid train for a carbon source for releasing phosphorus.

The proposed annual costs include annual marketing, hauling, and disposal cost that reflects the optional biosolids program management offered by Lystek. Their system's output has a high affinity towards a saleable product, due to the added potassium and Class A status.

Since this alternative no longer utilizes the digested sludge gravity belt thickener, this existing device may be repurposed for full-time raw sludge thickening and thereby offset costs associated with new equipment for that purpose. Cost savings to offset this investment are included in this alternative.

The liquid sludge system costs were minimized by excluding redundant systems and extending operational hours. Thus, when the system experiences unexpected shutdowns the system will stop producing the "de-tuned" cake and the belt press "high-solids" settings can be restored to discharge cake to the biosolids truck for normal cake land application purposes.



Figure 22 – Thermal Hydrolysis Reactor Example

Advantages

- Potential to produce Class A biosolids
- Annual land application ability
- Improves fertilizer value to farmers, with revenue potential

- Reuse of existing equipment and structure
- Minimal site footprint required
- Lowest initial cost
- Amenable to phased installation

Disadvantages

- Retains similar land application reliance on weather
- Does not include future reinvestment costs for existing dewatering system repairs
- Retains use of the cake sludge shuttle truck system
- Additional chemical costs

Cost

\$12,348,000 initial cost, and annual costs of up to \$823,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$23,914,000.

BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)

Purpose and Description

Evaluation of the operating costs of the liquid and cake handling facilities indicated a lower operational cost associated with production of cake biosolids. The total cost for handling, polymer, labor, hauling, and land application is \$256/dry ton (liquid), and \$223/dry ton (cake). The majority of the higher costs for liquid are associated with trucking the liquid biosolids to the fields. However, the cost savings associated with an increased cake program can only be realized until the system reaches capacity.

This alternative provides improvements to the biosolids handling system to provide 330 days of sludge storage as half liquid and half cake biosolids. The increased diversity towards cake storage is anticipated to expedite land application during adverse weather. A new dewatering facility will be constructed adjacent to the proposed cake storage to eliminate the capacity limitation associated with the existing cake solids shuttle truck. An example image of cake biosolids land application is provided in Figure 23.

This plan would also require the expansion of the existing liquid storage to an additional 4.3 million gallons of liquid storage tanks similar to the facility's existing biosolids storage tanks.

Despite a reduced cost for land application, this alternative is the highest total present worth alternative. This is due to the high cost of storage, disposal of non-Class A biosolids, and continued use of liquid sludge for half of the material.



Figure 23 – Land Application of Cake Biosolids

Advantages

- Annual land application ability
- Continued operation familiar to plant staff.
- Minimal oversight dewatering operation
- Amenable to phased installation

Disadvantages

- Retains similar land application reliance on weather
- Not Class A biosolids
- Footprint
- Still relatively high truck traffic
- Hauling costs

Cost

\$11,526,000 initial cost, and annual costs of up to \$1,094,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$26,900,000.

BR-1cr Increase Cake Handling and Improve Logistics via Remote Cake Storage

Purpose and Description

This alternative is very similar to BR-1c (see above), in that additional sludge storage is provided for both liquid and cake biosolids, with a preference given to cake biosolids to increase the proportion of cake land applied. In an effort to expedite hauling (the slowest portion of the hauling system), two remote storage facilities would be developed. The proposed remote sites provide approximately 30-days of storage at each of two locations, depicted in Figure 24. The proposed remote sites are scoped for construction on typical load bearing soils, thus a capital cost savings for deep pile foundations was identified.

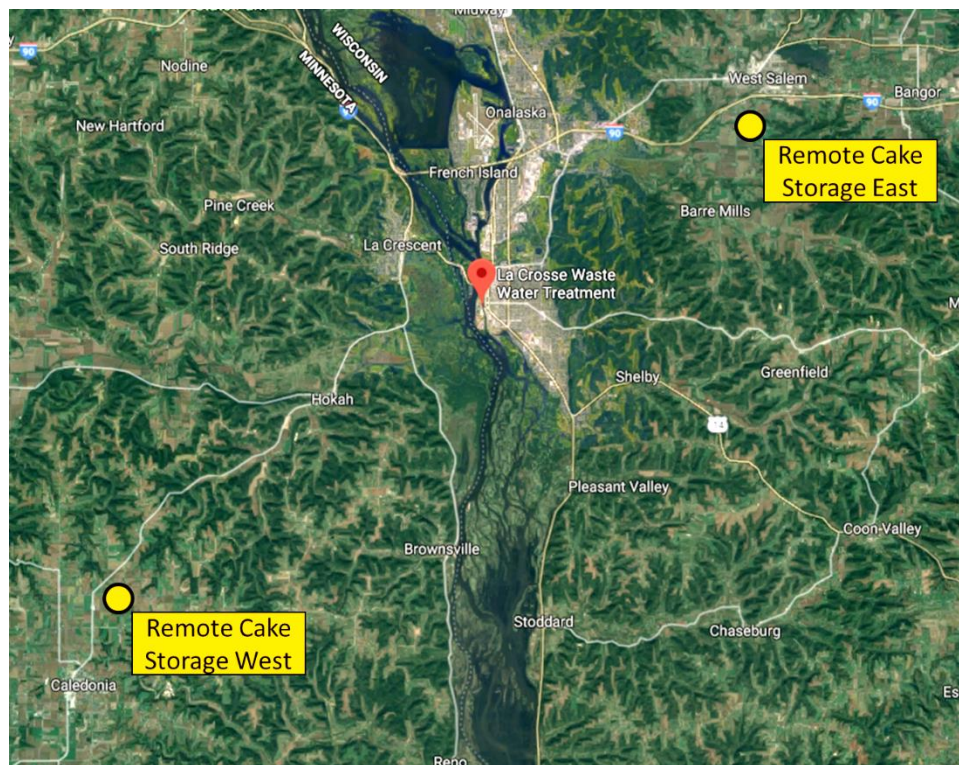


Figure 24 – La Crosse Regional Area

Advantages

- Annual land application ability
- Continued operation familiar to plant staff.
- Minimal oversight dewatering operation
- Amenable to phased installation
- Decreased truck traffic during land application

Disadvantages

- Retains similar land application reliance on weather
- Not Class A biosolids
- Regular hauling to remote site

Cost

\$11,181,000 initial cost, and annual costs of up to \$1,000,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$25,234,000.

BR-1d Increase Diversity (30% Liquid 70% Dried Biosolids Belt Dryer, with Cake Optional)

Purpose and Description

This alternative provides additional opportunities for biosolids reuse by adding techniques that create a product that can be reused all year. Utilizing less than half of the total biosolids for land application limits the City from being subject to weather related uncertainty associated with the land application program. Of the available methods to achieve Class A Exceptional Quality (EQ) biosolids status, thermal

drying was selected to provide a high-rate, controllable, and minimal footprint process alternative. The total present worth cost of this alternative was optimized by recognizing the intrinsic value of the existing liquid storage tanks. These tanks provide 30% of the projected total biosolids storage requirement, thus a dryer was sized to handle 70% of the biosolids production capacity to avoid the need to build additional storage. Since the heat drying system requires a dewatered cake, the City may retain its ability to land apply a Class B cake for increased biosolids reuse diversity. However, it is anticipated that due to the convenience and predictability of sludge drying, it will be the primary method for biosolids handling.

Thermal drying is listed as a process to further reduce pathogens (PFRP) in 40 Code of Federal Regulations (CFR) Part 503 and utilizes heat to evaporate water from biosolids to produce a Class A product. 40 CFR Part 503 requires that the dryer reduce the moisture content in the biosolids to less than 10% and the temperature of either the biosolids or the wet bulb temperature of the gas in contact with the biosolids exceed 80°C (176°F). Dryers are classified by the method of heat transfer to the wet solids; the two main classifications are convection (direct) and conduction (indirect). Direct dryers consist of heating gas that comes into direct contact with the wet solids, whereas indirect dryers transfer heat from hot oil or steam to the wet solids via a solid plate. Common direct dryers include the rotary drum dryer and the belt dryer. Common indirect dryers include the fluidized-bed dryer, tray dryer, paddle dryer, and rotary chamber dryer. The belt dryer typically provides the most flexibility for using alternative energy sources and for recovering energy, as it utilizes the lowest temperature regime to dry the biosolids. Due to the reduced energy use and increased safety, the belt dryer was selected for evaluation. A typical belt dryer arrangement is depicted in Figure 25.

The existing cake storage area will be repurposed to incorporate a new dewatering room with screw presses (or similar) for dewatering anaerobically digested sludge is anticipated to achieve 20% TS cake. The material is held in a small cake hopper prior to pumping to the sludge dryer. The sludge is evenly applied to the surface of the belt to increase surface area and slowly passes through heated air to evaporate water. Operated with air temperatures between 180°F to 200°F enable the dryer to utilize waste heat from biogas cogeneration equipment. The biosolids are dried to at least 90% TS; which combined with the applied heat, achieves the EPA Class A process to further reduce pathogens and for vector attraction reduction. A biosolids cooler is required to prevent undesirable fires if the product is placed into storage at high temperatures; however, with the low-temperature drying systems the need for a biosolids cooler may be site specific. The final product is conveyed to a storage silo system with a nitrogen purge for safe handling prior to loading trucks.

The dryer capacity is targeted for handling 70% of the sludge load at max week loadings, operating 120 hours per week (24 hour per day, 5 day per week). Continuous operation is efficient for the dryer; however, staff may elect to operate the facility at full capacity for shorter durations during average to low loading conditions. Utilization of recovered waste heat limits the dryer capacity. If dryer capacity is limiting throughput, natural gas may be needed to supplement for operation at higher temperatures (up to 400°F).

Preliminary discussions to haul the dried biosolids for combustion at local biomass power plants have been limited but promising. The main constraint with inputting the dried product to a biomass facility is safe and effective material handling to avoid a damaging public relations fire, and to avoid unwanted material handling complexity with blending the new product. Four major benefits to this consideration

are 1) the ability to off-load biosolids daily, 2) the elimination of a hauling cost, and potential to receive payment or renewable energy credits for diverting biosolids from a worst-case of landfilling, 3) that the biosolids energy is maximized to offset fossil fuels rather than used for fertilizer, and 4) incineration does not require Class A biosolids, which would enable the WWTP to operate the dryer at an aggressive rate to minimize costs and hazards.

Xcel Energy's representative (Brett Connoly) informed us that they have a fluidized bed incinerator located on French Island that is used to incinerate solid waste (Refuse Derived Fuel, RDF) from La Crosse County. The fluidized bed incinerator is the best type of incinerator for burning biosolids because the fluidizing sand bumps the ash off the particle and allows the fire to continue burning the particle. Less unburned ash is produced by this type of incinerator. The incinerator is located in the City of La Crosse and hauling cost would be low. Xcel, however, has a contract with the County of La Crosse to burn all the solid refuse in the county and is at capacity. Of the total amount incinerated, the City's WWTP biosolids would represent less than 10% of the system capacity. Major concerns for material handling and plugging concerns were identified by Xcel. For these reasons, at this time, Xcel will not accept the City's biosolids.

Dairyland Power's representative (Neil Kersback) stated in 2008 (during the previous facility planning) that they have a multiple-hearth incinerator. They burn pulverized coal that is sprayed into the incinerator. The incinerator requires a clean low-moisture fuel. The biosolids would need to be screened, dewatered, and dried before they could be hauled to the site and incinerated. The incinerator is located in Genoa City, Wisconsin. Dairyland would be willing to incinerate the biosolids and test for air stack emissions. The La Crosse biosolids volume would represent less than 1% of the estimated BTU value needed to generate electricity at their Genoa City facility. Dairyland would be willing to work with the City and provide some payback if the alternative is cost-effective. The amount of payback would be based upon the BTU value of the biosolids and the cost to test the air stack emissions.

Gundersen Lutheran Medical Center's facility manager (Alan Eber) met with the City and discussed the proposed concept, and was very interested. Gundersen installed a biomass to steam/electricity boiler system in 2013, which they use all year. Mr. Eber expressed confidence that air emissions would not be a deterrent and that their facility could accept biosolids without facility modification. Some minor feed rate and product receiving changes may be required to help make the project a success. Minor testing is required to confirm the residual ash content is acceptable. Gundersen is currently paying to receive wood chips, thus if WWTP biosolids were utilized they could help offset Gundersen's operating costs.

A biosolids drying project has a high initial commitment and capital investment, but drastically improves the diversity towards how biosolids are reused. This option would also transition the City's biosolids towards a Class A product, which could become a future regulatory requirement during the planning period.

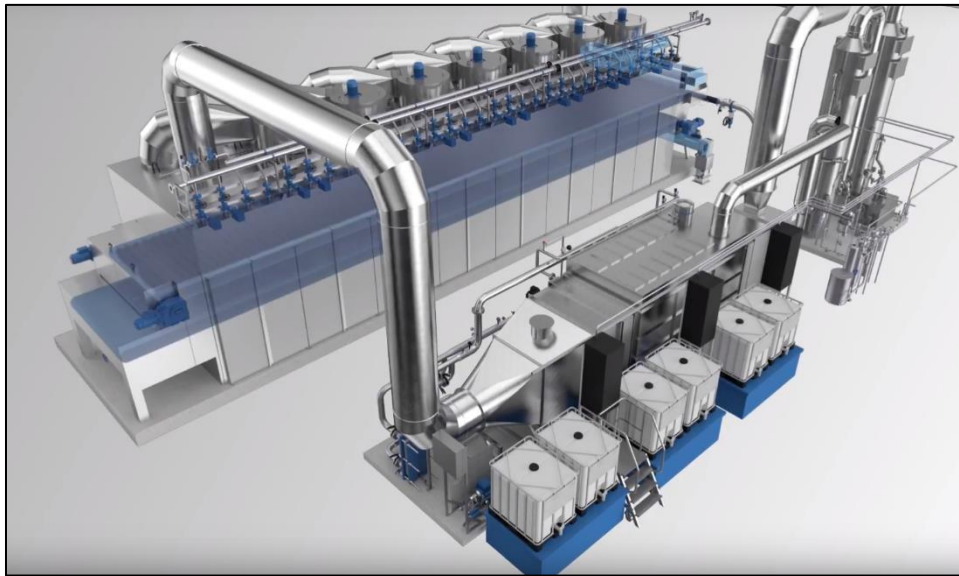


Figure 25 – Sludge Drying System

Advantages

- Partial Class A EQ biosolids
- High likelihood of decreased annual costs due to regular disposal of dried biosolids
- Very robust (future proof) technology/alternative for biosolids stabilization
- Retains liquid storage for cost-reducing opportunities and peak capacity
- Footprint

Disadvantages

- Increased operational complexity
- Increased safety concerns
- High initial cost, minimal phasing ability.

Cost

\$19,526,000 initial cost, and annual costs of up to \$536,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$27,059,000. A sensitivity analysis on disposal and natural gas expenses indicates that the total present worth of this alternative could range from \$25.5 million to \$30.7 million. Scenarios where biosolids reuse generates revenue would improve this financial analysis; yet, are not recommended to be relied upon for justification of this alternative.

BR-1e Increase Diversity (50% Liquid, 40% Cake, and 10% Dried Biosolids Solar)

Purpose and Description

This alternative provides a similar increased biosolids diversity approach as BR-1d, but provides biosolids drying using solar energy. Similar to belt dryers, solar dryers evaporate water from cake solids to produce a granular biosolids product. Solar dryers operate on the basis of relative humidity using large ventilation fans and a greenhouse effect to provide the evaporative load. Due to the lower loading rate, the surface area is much larger than a belt dryer, especially in northern climates. Typically, solar dryers

have a mobile sludge agitation device that stirs up the sludge, which can create approximately 70% TS material. Solar dryers have been tested and proven to meet Class A biosolids standards, however each installation is site specific and would require extensive testing. An example solar drying greenhouse is shown in Figure 26.

Due to the large area required for each module, only a few modules are able to be sited on the WWTP property. The available footprint restricts dried biosolids capacity to 10% of the total biosolids handling requirement, thus liquid and cake handling and storage are required for the remainder.



Figure 26 – Solar Drying Example

Advantages

- Potential Class A biosolids; requires testing to confirm
- Reduces solids disposal costs
- Low energy requirements
- Safer dried product handling
- Modular design

Disadvantages

- Footprint, limits capacity and consumes space for other treatment needs
- Difficulty achieving Class A status in the winter

Cost

\$13,729,000 initial cost, and annual costs of up to \$983,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$27,544,000.

BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)

Purpose and Description

Similar to alternative BR-1d, this alternative provides additional opportunities for biosolids reuse by processing all of the biosolids to create a product that can be reused all year. Developing a Class A Exceptional Quality biosolids that may be utilized for unrestricted reuse and has the potential to

eliminate the City from being subject to weather related uncertainty associated with the current land application program. This increased ability does not prevent reuse of the biosolids for land application (agricultural fertilizer), but opens new opportunities for more predictable year round uses. Of the available methods to achieve Class A Exceptional Quality biosolids status, thermal drying was selected to provide a high-rate, controllable, and minimal footprint. Operational complexity was minimized by sizing the drying system for 100% of capacity.

This alternative requires construction of many new facilities. In order to minimize the level of new construction, concepts to repurpose existing systems were included whenever feasible. For example, this alternative no longer utilizes the digested sludge gravity belt thickener, this existing device may be utilized to offset costs for raw sludge thickening. Additionally, any proposed cost for a sludge buffer tank (included in Alternative D-1) is not required, as only one method for biosolids handling and the existing liquid storage tanks may be utilized to hold digested sludge during an unplanned solids handling system shutdown. These respective cost savings are included in this alternative.

Since the heat drying system requires a dewatered cake, the City may retain its ability to land apply a Class B cake for increased biosolids reuse diversity. However, it is anticipated that due to the convenience and predictability of sludge drying, it would be the primary method for biosolids handling.

The same thermal drying discussions apply to this alternative as were discussed regarding operational temperatures, equipment types, material handling, and safety as were presented in Alternative BR-1d.

The dryer capacity is targeted for handling 100% of the sludge load at max week loadings, operating 120 hours per week (24 hour per day, 5 day per week). Continuous operation is efficient for the dryer; however, staff may elect to operate the facility at full capacity for shorter durations during average to low loading conditions. Utilization of recovered waste heat limits the dryer capacity. If dryer capacity is limiting throughput, natural gas may be needed to supplement for operation at higher temperatures (up to 400°F).

Preliminary discussions to haul the dried biosolids for combustion at local biomass power plants have been limited but promising. The main constraint with inputting the dried product to a biomass facility is safe and effective material handling to avoid a damaging safety and public relations fire, and to avoid unwanted hassle with blending the new product. Four major benefits to this consideration are 1) the ability to reuse biosolids daily, 2) the elimination of a hauling cost, and potential to receive payment or renewable energy credits for diverting biosolids from a worst-case of landfilling, 3) that the biosolids energy is maximized to offset fossil fuels rather than used for fertilizer, and 4) incineration does not require Class A biosolids, which would enable the WWTP to operate the dryer at an aggressive rate to minimize costs and hazards. The same biosolids incineration discussions apply to this alternative as were discussed regarding Xcel Energy, Dairyland Power, and Gundersen Lutheran as were presented in Alternative BR-1d.

This project has a high initial cost, but drastically improves the diversity towards how biosolids are reused. This option would also transform the City's biosolids into purely a Class A product, which mitigates future regulatory requirements that may develop during the planning period.

Advantages

- Class A EQ biosolids
- Simplified operational decisions
- High likelihood to offset annual costs due to regular disposal of dried biosolids
- Most future proof technology for biosolids stabilization
- Footprint

Disadvantages

- Decreased flexibility/diversity without liquid program
- Increased operational complexity
- Increased safety concerns
- High initial cost, potential phasing ability to install one of the two required dryers.

Cost

\$26,235,000 initial cost, and annual costs of up to \$556,000, which includes final disposal, thus, this cost should be contrasted against the status quo annual cost of BR-1a. The resultant 20-year total present worth is \$34,049,000. A sensitivity analysis on disposal and natural gas expenses indicates that the total present worth of this alternative could range from \$31.8 million to \$38 million. Scenarios where biosolids reuse generates revenue would improve this financial analysis; yet, are not recommended to be relied upon for justification of this alternative.

BR-1g Increase Diversity (50% Liquid 50% Cake to Compost)

Purpose and Description

This alternative was developed to produce an increased quantity of cake biosolids which would be further processed with composting techniques. Composting for Class A biosolids is a viable technique, but requires additional monitoring than merely composting yard wastes. The 2008 Facility Plan considered composting on Isle La Plume; however, was screened from consideration due to odor concerns. The concept of composting was revisited during this evaluation as a partnership with a local composting company which would stockpile bulking agent and biosolids outside of City limits.

This alternative was highly dependent upon cooperation with local composting business owner(s) and since no response was obtained, the evaluation was discontinued as it was not confirmed to be a viable partnership.

Advantages

- Not applicable.

Disadvantages

- Not applicable.

Cost

Not applicable.

BR-2 Improve Biosolids Quality

Purpose and Description

Primary sludge often contains a significant amount of non-biodegradable material that has bypassed influent screening and can accumulate in the digesters, solids handling systems, and biosolids. The City has been questioned about debris observed in the land applied material, which degrades the key public relations component of the biosolids reuse program. In order to extract these inert materials, facilities have successfully added a fine-mesh (5 mm) sludge screen that captures screenings from the raw sludge. The technology is often termed a strainpress, as it receives a pressurized sludge flow and the screenings are pressed out of the unit into a dumpster. The screened sludge is conveyed to digestion for stabilization with no hair or rags to re-agglomerate and consume effective digester volume or cause issues on future dewatering or potential drying systems. Common to screening raw wastewater, the screenings are washed and compacted to approximately 40% TS before being hauled to landfill.

This alternative provides redundant sludge screening for the entire flow of primary sludge using two units. Each unit, depicted in Figure 27, is capable of up to 440 gpm, and could be mounted upstream or downstream of the gravity thickener. If placed upstream of the gravity thickener, the screened sludge could flow by gravity to the gravity thickener and avoid adding another set of sludge pumps to the flow schematic. If placed after the primary sludge is thickened, the system is recommended to be located near the primary digesters.

The proposed system is not intended to screen WAS or TWAS as these streams are not commonly associated with adding debris to the sludge/biosolids. However, the proposed system, intended for primary sludge only, appears to have excess capacity that could be utilized for screening of TWAS if ragging concerns persist.

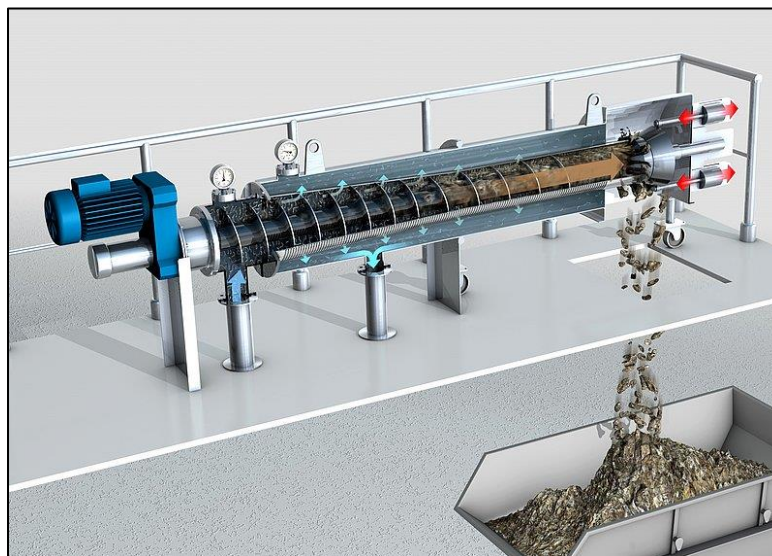


Figure 27 – Sludge Screen Schematic

Advantages

- Decreased requirement for digester cleaning
- Decreased ash content of biosolids after incineration

- Decreased biosolids drying maintenance shutdown events and duration with respect to debris
- Increased runtime before failure for positive displacement sludge and cake pumps

Disadvantages

- Increased landfill costs
- Potential for additional sludge pumping
- Site footprint

Cost

\$1,122,00 initial cost.

Biogas

BG-1 Replace Waste Gas Burner

Purpose and Description

A waste gas burner is used to flare the excess gas. The City is planning for increased loadings from the collection system as well as increases to the hauled-in waste program and digestion improvements, all of which will produce more gas. The gas is normally intended to be used for heat and power generation; however, excess gas will need to be flared when these systems are offline or not consuming more than the produced amount. The existing waste gas burner can pass 22,500 cubic feet of gas per hour and is not automatically ignited. This rate may be insufficient at specific operating conditions. If the waste gas burner does not have sufficient capacity then the gas pressure will build and gas will vent from the digester covers' pressure relief valves. Emergency venting out relief valves is provided to prevent cover damage and/or tipping, but is not acceptable for excess gas venting. The need for a second (or replacement) waste gas burner should be evaluated as the City proceeds with solids handling improvements. An example waste gas flare system is shown in Figure 28.



Figure 28 – Waste Gas Flare Example

Advantages

- Auto ignite (higher destruction of volatile compounds)
- Higher capacity system

Disadvantages

- None

Cost

\$374,000 initial cost.

BG-2 Biogas Storage

Purpose and Description

Currently, biogas is stored under the floating gas holder cover of one digester. When this digester is taken offline, there is no effective biogas storage. To decouple the digester operation from gas storage, remote, pad-mounted storage was recommended. Additionally, this type of system increases the quantity and control of biogas storage for future biogas utilization.

This alternative is for the construction of a new biogas storage membrane remotely mounted from the digester complex. The size of the storage provides a 12-hour detention for potential peak shaving capabilities. An example installation is pictured in Figure 29.



Figure 29 – Remote Biogas Storage Example

Advantages

- Large storage volume, minimize wasted gas energy
- Enables cogeneration system to operate in peak shaving mode
- Decoupled from digester status

Disadvantages

- Electrical fan required for pressurization
- Additional site space required

Cost

\$1,191,000 initial cost.

BG-3a Baseline Energy Consumption

Purpose and Description

Currently, the biogas is only utilized in the sludge boilers. This alternative serves as a baseline to compare with new biogas utilization alternatives in a manner that represents the opportunity expense associated with the status quo during the same 20-year period.

The proposed baseline energy cost uses historical electric utility bills and adds an additional 30% power demand for an assumed set of recommended improvements (phosphorus removal, sludge thickening, and digester mixing).

Advantages

- No capital investment

Disadvantages

- High annual cost
- Wasted renewable biogas energy

Cost

\$0 initial cost, and projected annual costs of up to \$618,000. Note, this is the projected case of the cost that the WWTF is currently paying. The resultant 20-year total present worth is \$8,685,000.

BG-3b Cogeneration Engine

Purpose and Description

Installation of new biogas fueled engine-generator along with gas treatment system for moisture, siloxane and sulfide removal is proposed for this alternative.

Based on the historical gas production and potential future conditions, one 400-kW high efficiency engine generator could be installed and run continuously. Due to the advantageous exhaust and engine block heat recovery, natural gas may not be required to heat the digesters. The gas from the digesters would be cleaned to remove moisture, hydrogen sulfide and siloxanes. Moisture and hydrogen sulfide is removed to prevent corrosion. Siloxanes deposit on hot moving engine parts causing additional wear and can ultimately lead to complete failure. The operation and maintenance costs reflect routine maintenance as well as media replacement and long term overhaul costs. The new engine would be located in an outdoor enclosure north of the digesters, near the cold storage building. An example of these packaged systems is depicted in Figure 30. An alternate location could be inside the cold storage building if the school district allows use of the building. A new gas conditioning room is included to improve operation and maintenance on the key components of the gas skid.

The recovered heat would be sent to the digester gas boiler system for process and potentially building heat. Power that is generated will be conditioned through switchgear and synchronized with the incoming line power for use in the facility's electric power grid via the proposed main switchgear at Plant 2. Cogeneration could be integrated to the existing 2400V main gear, but would require a step-up 480V:2400V transformer that would be replaced when the main gear is updated. The engine generator system typically exhibits modulating turndown for moderate flexibility for pacing to gas production based on available gas in storage. Although a second engine is not provided, this should be considered for future expansion. Backup power diesel engine generators are already familiar to plant staff, which are relatively similar to cogeneration systems.



Figure 30 – Cogeneration Example

Advantages

- Minimized capital cost
- Engine is always fully utilized

Disadvantages

- Peak biogas not fully utilized
- Does not offset entire WWTP electrical demand

Cost

\$3,907,000 initial cost, the projected annual costs of \$618,000 will be reduced by power generation offsets of \$261,000; however added maintenance costs of \$88,000 per year are expected. The net energy savings results in an estimated simple payback of 17-23 years. Focus on Energy grants are typically awarded to renewable energy projects like this, and assist in decreasing the payback period by a year or two.

BG-3c Peak Shaving Cogeneration Engine

Purpose and Description

This alternative is similar to Alternative BG-3b (cogeneration engine with gas treatment), but provides a larger generator to utilize more biogas. Installation of a larger biogas fueled engine-generator would result in more periods of exporting energy. The buy-back (exporting) electric rate from Xcel energy is not heavily incentivized for new contracts. Xcel indicated 2019 agreements would provide \$0.03202/kWh and \$0.02391/kWh for on-peak and off-peak, respectively. The more cost-effective strategy is to offset WWTP electricity usage, and maximize the offset of all peak usage charges as these cost \$0.076/kWh, which is 50% more than the off-peak rate, excluding demand charges.

In tandem with 12-hours of biogas storage (identical to Alternative BG-2, included herein), this engine will be able to utilize nearly all of the biogas and provide more kW during the peak kW-hr period at the facility and thus reduce monthly charges significantly. Power demand meters could be added to a new main switchgear to alert the operations staff to ramp up the engine generator for optimal peak demand shaving abilities.

Based on the historical gas production and potential future conditions, one 600-kW high efficiency engine generator could be installed and run continuously. Due to the advantageous exhaust and engine block heat recovery, natural gas may not be required to heat the digesters. The gas from the digesters would be cleaned to remove moisture, hydrogen sulfide and siloxanes. Moisture and hydrogen sulfide is removed to prevent corrosion. Siloxanes deposit on hot moving engine parts causing additional wear and can ultimately lead to complete failure. The operation and maintenance costs reflect routine maintenance as well as media replacement and long term overhaul costs. The new engine would be located in an outdoor enclosure north of the digesters, near the cold storage building. An alternate location could be inside the cold storage building if the school district allows use of the building. A new gas conditioning room is included to improve operation and maintenance on the key components of the gas skid.

The recovered heat would be sent to the digester gas boiler system for process and potentially building heat. Power that is generated will be conditioned through switchgear and synchronized with the incoming line power for use in the facility's electric power grid via the proposed main switchgear at Plant 2. Cogeneration could be integrated to the existing 2400V main gear, but would require a step-up 480V:2400V transformer that would be replaced when the main gear is updated. The engine generator system typically exhibits modulating turndown for moderate flexibility for pacing to gas production based on available gas in storage. Backup power diesel engine generators are already familiar to plant staff, which are relatively similar to cogeneration systems.

Advantages

- Optimized capital cost with biogas utilization (better economy of scale)
- Additional capacity to capture current and future gas production
- Includes Alt BG-2 costs
- Potential to offset entire WWTP electrical demand

Disadvantages

- More complicated operational strategy to maximize return on investment

Cost

\$5,344,000 initial cost, the projected annual costs of \$618,000 will be reduced by power generation offsets of \$373,000; however added maintenance costs of \$110,000 per year are expected. The net energy savings results in an estimated simple payback of 16-20 years. Focus on Energy grants are typically awarded to renewable energy projects like this, and assist in decreasing the payback period by a year or two.

BG-3d Cogeneration Microturbine

Purpose and Description

Installation of new biogas fueled microturbine generators along with gas treatment system for moisture, siloxane and sulfide removal is proposed for this alternative.

Based on the historical gas production and potential future conditions, two 200-kW (or six 65-kW) microturbine generators could be installed and run continuously.

Unlike reciprocating engines, microturbines lack engine block heat recovery, thus natural gas is anticipated to heat the digesters. The gas from the digesters would be cleaned to remove moisture, hydrogen sulfide and siloxanes. Moisture and hydrogen sulfide is removed to prevent corrosion. Siloxanes deposits are extremely damaging to microturbines, which operate at very high rpms and can ultimately lead to complete failure. The operation and maintenance costs reflect minimal maintenance, but include a long-term (10-year) expected overhaul of the entire turbine core. The new units would be located in separate outdoor enclosures north of the digesters, near the cold storage building. A similar example is depicted in Figure 31, below, from Sheboygan, WI. An alternate location could be inside the cold storage building if the school district allows use of the building. A new gas conditioning room is included to improve operation and maintenance on the key components of the gas skid.

The recovered exhaust heat would be sent to the digester gas boiler system for process and potentially building heat. Power that is generated will be conditioned through switchgear and synchronized with the incoming line power for use in the facility's electric power grid via the proposed main switchgear at Plant 2. Cogeneration could be integrated to the existing 2400V main gear, but would require a step-up 480V:2400V transformer that would be replaced when the main gear is updated. The engine generator system typically exhibits modulating turndown for moderate flexibility for pacing to gas production based on available gas in storage.



Figure 31 – Microturbine Example

Advantages

- Low maintenance
- Multiple units enable continued generation during maintenance

Disadvantages

- Does not provide adequate heat recovery for the steady 2 MMBTU sludge heat load
- Reduced total energy captured
- Local installations have experienced reliability/robustness concerns

Cost

\$3,929,000 initial cost, the projected annual costs of \$618,000 will be reduced by power generation offsets of \$212,000; however added maintenance and energy costs of \$60,000 per year are expected. The net energy savings results in an estimated simple payback of 23-26 years. Focus on Energy grants are typically awarded to renewable energy projects like this, and assist in decreasing the payback period by a year or two.

BG-3e Pipeline to Utility

Purpose and Description

This alternative captures 100% of the biogas and provides gas conditioning to create a pure methane gas (similar in characteristics to natural gas) which can be exported (sold) to the natural gas utility. The current legislature provides incentives to the generation of renewable fuel credits, especially those linked to use in vehicles. The payment for these Renewable Identification Numbers (RINs) is currently very attractive, in that systems could show a payback in under 5 years. However, the compressed natural gas market is growing but still in its development, therefore, the ability to claim long-term credits is concerning.

New private venture capital companies are exploring this market and may offer a risk-adverse option that enables the City to tap into this attractive RIN market with a minimal investment usually through a

vehicle fueling system. These systems are usually structured to control revenue sharing such that the private entity is paid first; however, careful negotiation of contracts could result in a favorable option. A positive feature of these systems is that the gas treatment investment is also amenable to cogeneration.

A major capital cost to this system is the gas treatment, compression, and conveyance to the nearest interstate transmission line per guidance from natural gas utility representatives. The gas handling system is depicted in Figure 32. Xcel Energy services the local natural gas lines; however, Northern Gas owns the transmission line which crosses the Mississippi River at Barron Island, 1.5 miles upriver. The proposed system would use trenchless construction to install an HDPE gas line from the WWTP to the transmission line. The receiving line pressures are unknown, but were estimated at 1,000 psi for system sizing and O&M costs.

Since this alternative utilizes 100% of the biogas to generate RINs, no biogas would be available for heating at the WWTP; which requires the purchase of natural gas. However, given the current incentives the cost differential makes this concept a financially feasible alternative that some utilities are moving forward with construction.

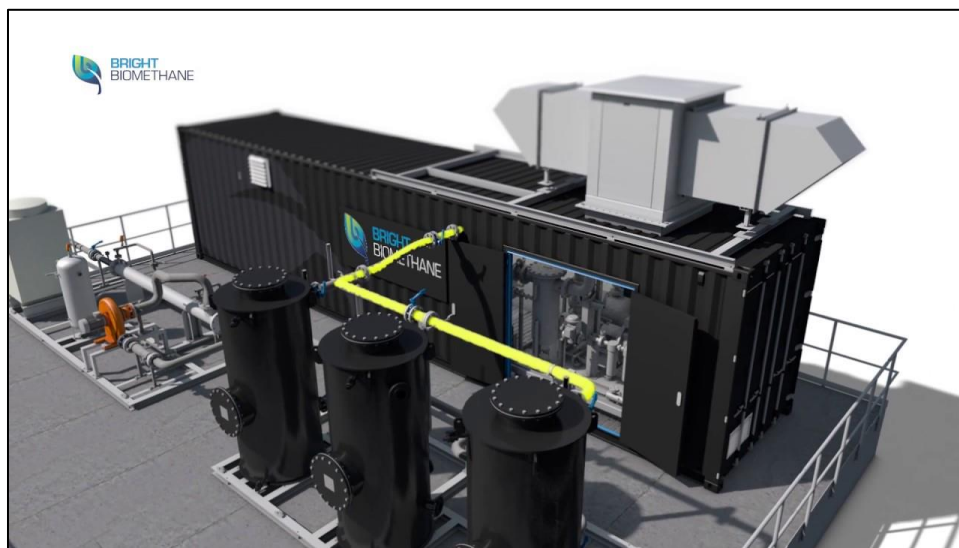


Figure 32 – Biogas Cleaning and Compression System Example

Advantages

- 100% biogas utilization
- Currently high value for renewable energy credits

Disadvantages

- Unsustainable economics, requires purchase of natural gas
- Difficult communication/cooperation with natural gas utility
- Environmental/wetland restrictions
- Liability concern with high pressure gas leaks/explosions

Cost

\$9,014,000 initial cost, the projected annual costs of \$618,000 will be reduced by RIN sales of \$473,000; however added maintenance and energy costs of \$76,000 per year are expected. The net energy

savings results in an estimated simple payback of 23 years, pending certainty of the RIN market. Focus on Energy grants are typically awarded to renewable energy projects like this, and assist in decreasing the payback period by a year or two.

Site and Utilities

U-1 Replace Facility Wide Heating System

Purpose and Description

The existing heating system in the facility includes two boiler systems with hot-water heat, and unit heaters at various locations. The boilers heat Plant 1 and the dewatering/chemical buildings. The boilers are old, at the end of their useful life, and in need of replacement. Some of the unit heaters are also in need of replacement. A facility-wide heating system would replace the existing boilers with either hot-water heat. The new boilers would be more efficient and could work in cooperation with the anaerobic digestion heating system. Digester gas would be the main fuel to heat the facilities through the digester gas boilers discussed in Alternate D-1 or D-2 and natural gas fired backup boilers would be used as needed. There is presently sufficient excess gas to provide at least 1.5-MMBH of heat to the building heating system.

The boilers would be located near or with the digester heating boilers in a central area. The boilers create hot water to match with those heating the anaerobic digesters. Eliminating 1.5-MMBH of natural gas consumption has the potential to save \$50,000/year. However, not all of these savings will be directly seen as an offset, but rather an avoidance because building heating requirements should increase as the ventilation rates increase to meet NFPA 820 code requirements for wastewater treatment facilities. This will impact the boiler size and fuel requirements for the plant.

Advantages

- Equipment replacement
- Improved efficiency
- Utilization of digester gas
- Reduced maintenance

Disadvantages

- Routing gas or heat loop to each room

Cost

\$605,000 initial cost.

U-2 Comply with NFPA 820 & 10-State Standards for Buildings

Purpose and Description

NFPA 820 is the Standard for Fire Protection in Wastewater Treatment and Collection Facilities. This standard has been adopted to provide guidance for determining classification of hazardous spaces in treatment facilities. Based upon the classification of hazardous spaces, ventilation and equipment requirements are determined. The intent of the document is to develop safeguards against fire and explosion hazards.

This alternative provides improvements to existing structures up to code to improve safety, equipment longevity, and enable modifications to electrical and controls. The wastewater facilities were generally reviewed for conformance with NFPA 820 and found to have a need to implement additional ventilation, equipment changes and/or separation to meet the intent of the standard. The Administration Building, Plant 1, and Primary Effluent Pump Building, Plant 2, need separation and additional ventilation. The Digester Building also requires separation of equipment from the gas handling equipment (drip and condensate traps) as well as ventilation improvements. The Dewatering and Liquid Sludge Storage Buildings require upgrades to their ventilation.

Advantages

- Improved safety and equipment life.
- Comply with hazardous code requirements
- Prevent fire and explosion
- Improved aesthetics in hazardous rated areas

Disadvantages

- Requires physical separation
- Operational expense for increased ventilation rates

Cost

\$2,183,000 initial cost.

U-3 Increase W3 System Capacity

Purpose and Description

The facility installed a reclaimed effluent (W3) system to service process needs throughout the facility instead of purchasing potable water from the La Crosse Water Department. Historically, the annual cost for water purchase was roughly \$120,000. The W3 system provides sufficient capacity for the existing gravity belt thickener, but cannot sustain supply to other major loads such as the belt filter press simultaneously.

This alternative would construct additional plant water (W3) pumps for higher capacity, chlorination system, controls, piping and valves to provide the non-potable water needs. Two additional 150 gpm pumps are included to increase the capacity of the W3 system for operation of new mechanical sludge dewatering equipment.

Advantages

- Minimizes use of City water supply to supplement during periods of heavy water demand

Disadvantages

- None

Cost

\$369,000 initial cost.

U-4 New Transformers and One Electrical Service

Purpose and Description

This project provides new primary metering and switchgear from the utility with increased redundancy for long-term reliability and reduced maintenance. The new main power distribution gear will backfeed new 13.8 kV transformers to step power down at all existing transformers to 480 V, as opposed to the current and obsolete 2400 V distribution system.

The proposed system includes the following:

- A fusible 13.8 kV switchgear cabinet of four sections: Primary Meter, Disconnect, and a pair of redundant feeders to the indoor main power distribution. The redundant main-tie-main arrangement minimizes single point failures. This gear would be exterior on the utility feed west of the Plant 2 building.
- An indoor 13.8 kV distribution board of feeding the following: Plant 1, Plant 2, Sludge, UV Disinfection, and Future Cogen. These sections would feed new 13.8 kV concrete encased ductbanks to each respective building. New 13.8 kV stepdown to 480 V transformers would replace the current 2400 V to 480 V transformers across the site. This new 13.8 kV distribution board could be constructed adjacent to the existing 2400 V system; and as loads are transferred, added sections can be located in place of removed sections to optimize layout in the Plant 2 Blower Room.
- Consideration could be given to purchasing the existing utility owned 13.8 kV to 480 V UV transformer.
- Two of the existing 400kW 480V standby generators (serving Plant 1 and Plant 2) are recommended for replacement. Replacement with natural gas was included to best-match the existing system; however, diesel power could be considered for a cost savings.
- The other two existing 480 V standby generators throughout the facility would remain and would be utilized to continue powering the facility during construction sequencing.
- A new 480V standby generator is recommended for providing reliable standby power to the HSi Blower system to serve operation of two existing blowers.

Advantages

- Single utility meter
- Enhanced plant redundancy and reliability
- Increased electrical system longevity
- Improved compatibility with future cogeneration
- Compliance with permit limits during power failure

Disadvantages

- Limited construction phasing options due to cost savings with merged systems

Cost

\$4,521,000 initial cost.

U-5 Floodplain and Site Access Improvements

Purpose and Description

One of the concerns at the facility is flooding due to high Mississippi River stages. Specifically, flooding occurs at the north end of the facility through the northwest gate. The City has historically sandbagged this location, which is time consuming and blocks the entrance until removed. The other portions of the site do not exhibit the same level of flooding risk, but should be reviewed further to avoid floodwaters from entering an alternate location. To block the intrusion of floodwaters, this project installs a flood control gate and improved earthen berms at that entrance. The flood gate is a double walled aluminum lift-hinged gate that does not require recessed ground channels or raised ground beams or ramps. When open, the gate swings 90-degrees and would be operated manually. High compression seals require a flat surface, thus mounting walls/abutments are included. The gate is ratcheted lower at the hinge upon closing the gate to create a tight seal, and is held down with a latch. A schematic of this type of gate is provided in Figure 33.



Figure 33 – Flood Gate Example

A lower cost method of flood control could consider 1) a stop-log style gate (manually inserted upon predicted high flood elevation similar to sandbags) or 2) a gradually elevated grade at the entrance to provide a passive bermed entrance. This option requires a topographical survey to confirm feasibility.

Also included in this option is a hydrogen sulfide control system for the La Crescent forcemain. A basic bioxide chemical feed system injects nitrate to the water to prevent the bacteria from making sulfides. This is a low-cost option for corrosion control; however, note that the system adds nitrates which are undesirable from a biological phosphorus removal perspective.

Advantages

- Reduced risk of flood hazard
- Reduced labor to establish protection
- Increased access pre- and post- each event

Disadvantages

- Adds complexity to truck traffic access and existing security gate

Cost

\$361,000 initial cost.

Alternatives Summary

The alternatives were presented and discussed in depth at the Alternatives Evaluation Workshop. The project team selected the following lowest initial cost items, listed in Table 1, as “baseline” improvements that would be required to continue the current treatment requirements. These serve as a minimum standard for which modified packages can be considered.

Table 1 – Baseline Improvements Package

Unit Process	Alternative	Description
Headworks	H-1	Fine Screen Replace the existing comminutors with a second fine screen
	H-2	Grit System Programming Revise grit system programming to react faster to incoming peak flows
	H-3	HVAC Replacement Replace existing headworks make up air units and exhaust fans
	H-4	Septage and Holding Receiving Add new septage and holding waste receiving facilities to controllably receive waste from regional haulers serving the greater La Crosse County area not in the sewer service area
Primary Clarification	PC-1	Scum Pit 3 (Scum Pump) w/ HSW Revise existing scum handling system for Primary Clarifiers No. 1, 2, and 3 inclusive of additional high strength waste receiving for anaerobic digestion
	PC-2	HSW and Septage Receiving at GT 1 Repurpose Gravity Thickener No. 1 to equalize loadings of high strength waste for anaerobic digestion
Activated Sludge	AS-1	A/S Reactor Splitter Box Add new primary effluent splitter box prior to the activated sludge reactors for improved biological stability and performance
	AS-2	Large Blade Submersible Selector Mixers Replace existing selector zone mixers with more efficient large blade submersible mixers
	AS-3	Modified UCT Revise existing unaerated selectors to the modified University of Cape Town (UCT) process for improved nutrient removal
	AS-4	Sec Clar Splitter Box Add new mixed liquor suspended solids splitter box prior to the secondary clarifiers for improved effluent quality when loaded uniformly

Unit Process	Alternative	Description
	AS-5b	Modify RAS Piping to Minimize Deposition Add new buried valves on the existing return activated sludge suction piping to facilitate system maintenance
	AS-6	Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal Future planning level cost for new secondary clarifier mechanisms with improved flocculating inlets and rapid sludge withdrawal
	AS-7	Sec Clar Density Current Baffles Add new density current baffles to existing secondary clarifiers for improved effluent TSS quality
Effluent Phosphorus Treatment	EP-1b	Outside-In Cloth Disk Filter with Coagulation Zones Add new right-sized, tertiary pumping system, chemical conditioning system for phosphorus precipitation, and disc filters prior to disinfection
	EP-2	Clarifier Launder Covers Add new secondary clarifier effluent launder covers to minimize algae growth prior to the tertiary disc filters
Disinfection	DI-1	Replacement UV System Future planning level cost for effluent ultraviolet disinfection system replacement when existing system reaches its end of useful life
Sludge Thickening	ST-1d	Separate WAS Sludge GBT and Struvite Control Add new gravity belt thickener system to provide WAS thickening to improve anaerobic digestion detention time. Piping will include the ability to process primary sludge for future phased digestion thickening needs.
Digester Operation, Heating, and Recirculation	D-1	Mesophilic Digestion Replace existing digester heating system with new boilers, heat exchangers, recirculation pumps, and heat loop system
Digester Mixing	DM-1	Digester 1&4 Draft Tube 2&3 Jet Mixing Add new digester mixing systems to each digester
Biosolids Reuse	BR-1a	Status Quo (80% Liquid 20% Cake to Land Application) Add additional liquid and cake biosolids storage volume to increase capacity for annual biosolids land application.
	BR-2	Improve Biosolids Quality Add new primary sludge screen to remove debris prior to thickening, digestion, and land application or drying
Biogas	BG-1	Replace Waste Gas Burner Replace existing biogas waste gas burner with larger capacity automatic flare for improved emissions control
	BG-3a	Baseline Energy Consumption Continue purchasing energy from the electric utility as needed for current and future treatment needs.
Site and Utilities	U-1	Replace Facility Wide Heating System Replace existing aging, independent, and inefficient house boilers with a facility wide heating system connected to the digester heat loop
	U-2	Comply with NFPA 820 & 10-State Stds for Buildings Replace existing ventilation systems, provide physical separation for

Unit Process	Alternative	Description
		hazardous areas, and modify electrical systems to comply with National Fire Protection Association (NFPA) 820 and State code for buildings
	U-3	Increase W3 System Capacity Revise existing non-potable effluent water pumps to increase system capacity for proposed systems
	U-4	New Transformers and One Electrical Service Replace existing electrical services, main distribution gear, conduits and conductors, and transformers to all facility motor control centers. Also replace and add key standby generators.
	U-5	Floodplain and Site Access Improvements Revise existing site entrance to provide improved flood control and revised pavement for hauler access

The total initial cost of this Baseline Package is approximately \$43.6 million; with a 20-year total present worth of \$74.5 million.

Detailed in TM1, methodology was outlined to evaluate and consider alternatives that may have a higher initial cost, but provided a higher value, either as a lower total present worth or better non-economic score. This technique enables the City to use a big-picture “end-in-mind” approach, to avoid the potential of constructing facilities that would limit future flexibility or expansion.

Non Economic Evaluations

The following evaluations present non-economic evaluations developed by the project team for three unit processes identified to have potentially improved project value if a non-baseline alternative was selected. The following unit processes were reviewed in detail:

- Digester Operation, Heating, and Recirculation
- Biosolids Reuse
- Biogas Utilization

Each evaluation contrasted the relative score between the baseline, and proposed alternatives for five main categories:

- Operability and Maintenance
- Resiliency, Stability, and Robustness
- Quality of Life
- Environment Stewardship and Sustainability
- Longevity and Flexibility

As prescribed in TM1, each alternative was scored from 1-5 in each of these areas, and a weighting factor was applied based on the overall importance of that category to the WWTP’s end goals. Figure 34, Figure 35, and Figure 36 exhibit the result of this non-economic review. Although selection of the preferred alternative is priority, the project team kept a focus on costs by including the total present worth on each figure. This enabled the team to review the alternatives’ economic and non-economic values simultaneously.

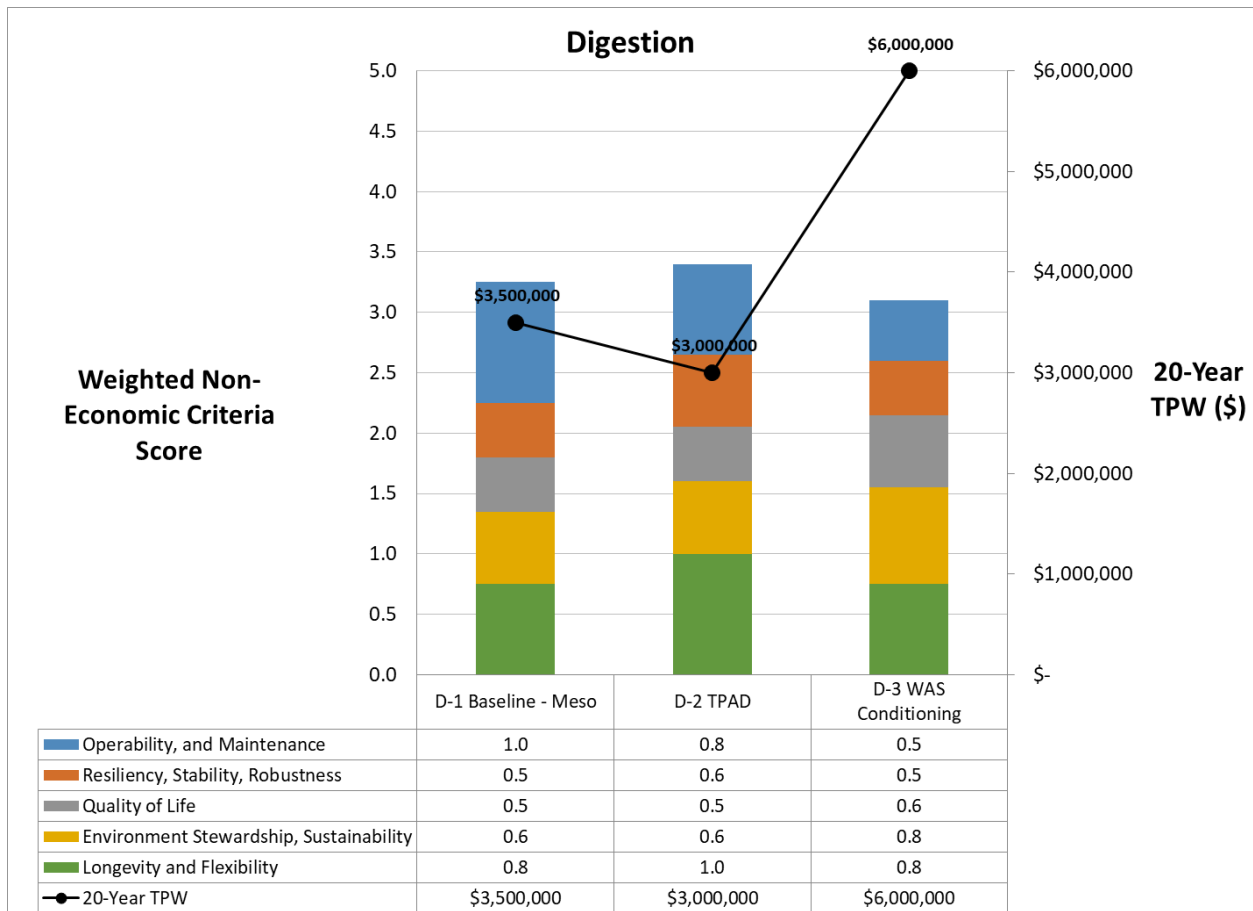


Figure 34 – Digester Operation, Heating, and Recirculation Non-Economic Scores

As exhibited in Figure 34, Alternative D-2 (TPAD) provides a higher non-economic score at a lower total present worth and is recommended to replace the baseline Alternative D-1.

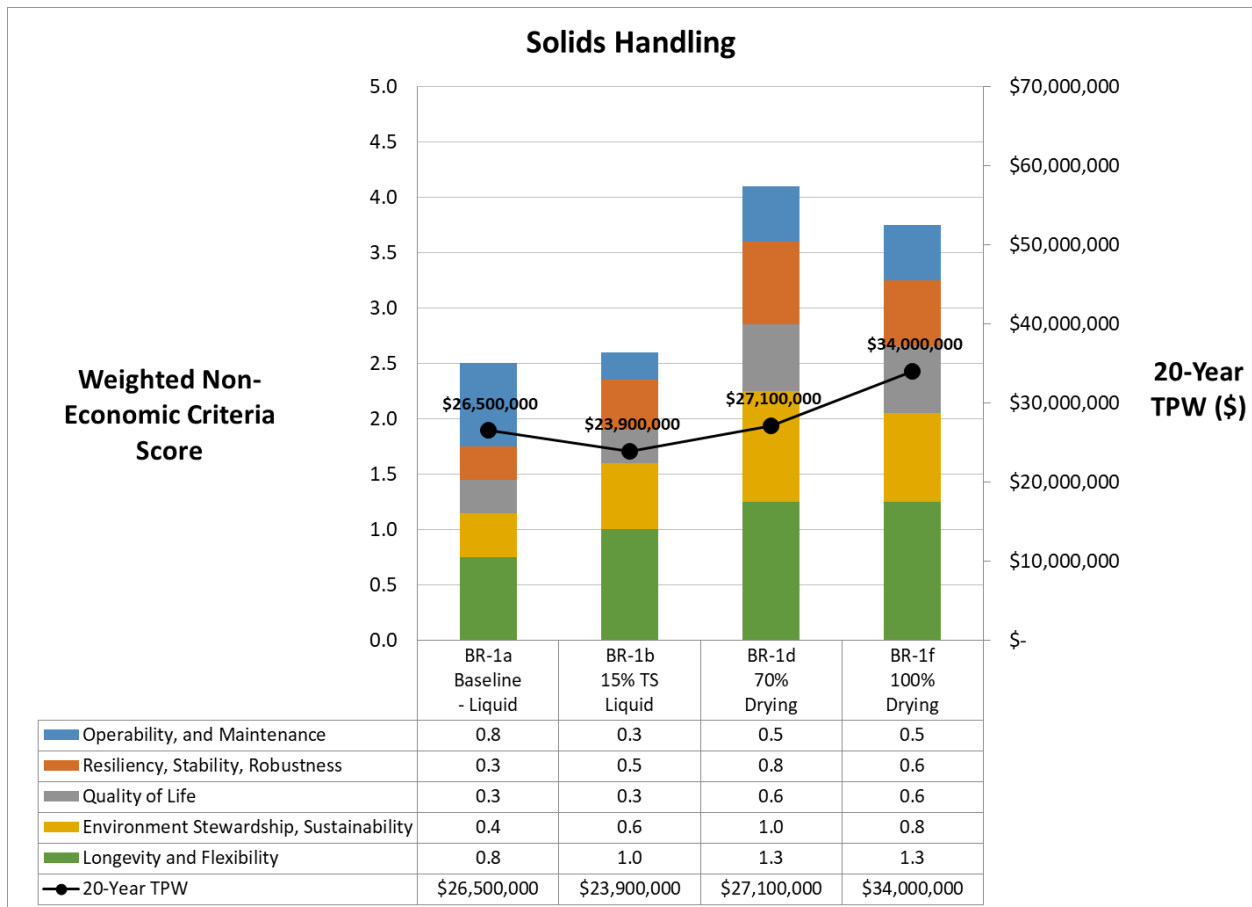


Figure 35 – Biosolids Reuse Non-Economic Scores

As exhibited in Figure 35, Alternative BR-1b (15% TS Liquid) provides a similar non-economic score, at a lower total present worth. However, the significantly higher non-economic score, and similar total present worth to the baseline for Alternative BR-1d provides a larger value to the City and is recommended to replace the baseline Alternative BR-1a. Due to conservatism applied to the projected operating costs, Alternative BR-1d has a high potential to further reduce the total present worth with a network of dried biosolids end users.

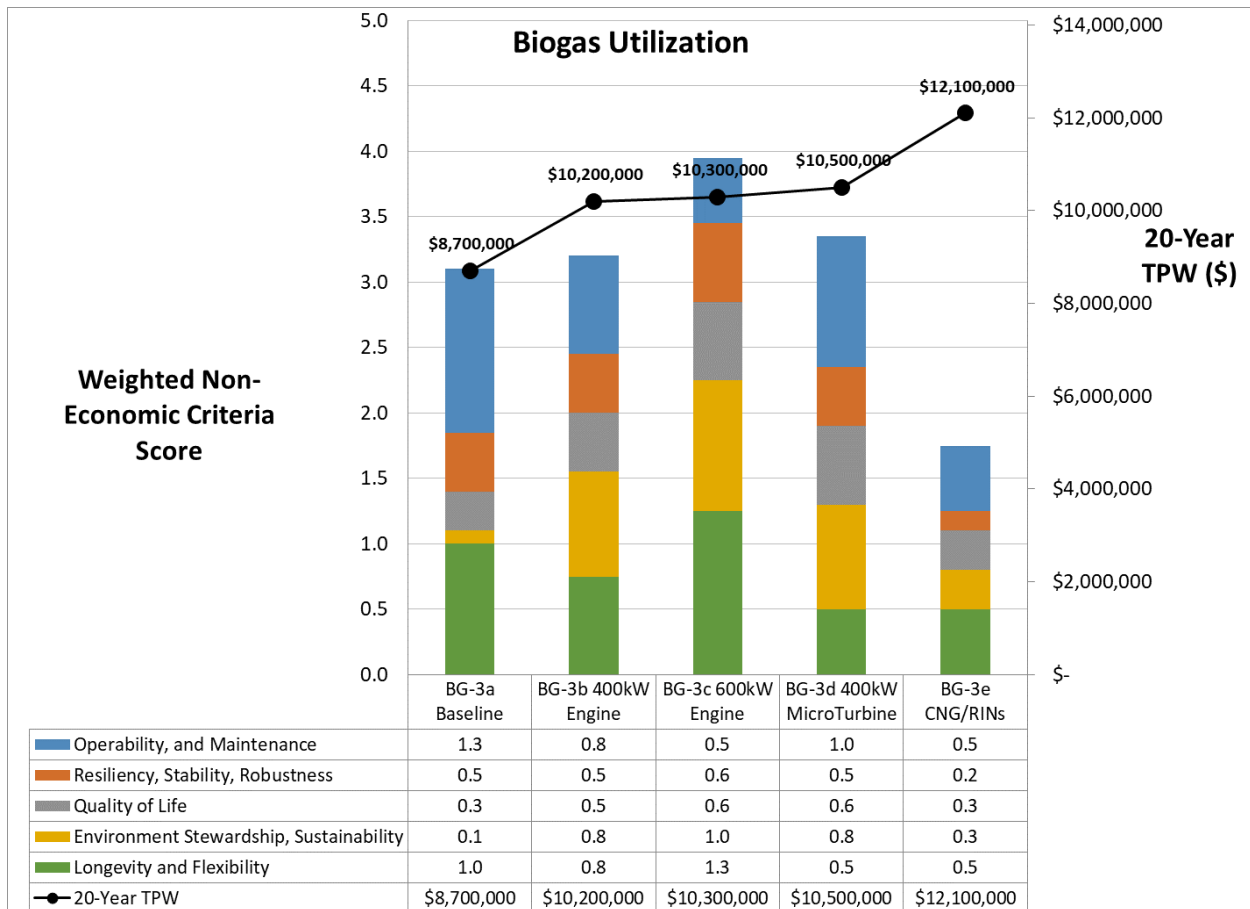


Figure 36 – Biogas Utilization Non-Economic Scores

As exhibited in Figure 36, Alternative BG-3c (600 kW engine) provides the highest non-economic score, at a slightly higher total present worth. The main non-economic factor which increased was Environment Stewardship and Sustainability. Alternative BG-3C is recommended to replace the baseline Alternative BG-3a as it involves paying a little extra (+15-20% total present worth) to gain a lot more value to the community. This vision aligns well with the La Crosse City and County Sustainability Goal 4H to achieve 25% renewable power by 2025 as identified in the 2009 Sustainability Plan.

Recommended Improvements

Modification of the Baseline Package results in the following listing of improvements, in Table 2:

Table 2 – Preferred Improvements Package A

Unit Process	Alternative	Description
Headworks	H-1	Fine Screen Replace the existing comminutors with a second fine screen
	H-2	Grit System Programming Revise grit system programming to react faster to incoming peak flows

Unit Process	Alternative	Description
	H-3	HVAC Replacement Replace existing headworks make up air units and exhaust fans
	H-4	Septage and Holding Receiving Add new septage and holding waste receiving facilities to controllably receive waste from regional haulers serving the greater La Crosse County area not in the sewer service area
Primary Clarification	PC-1	Scum Pit 3 (Scum Pump) w/ HSW Revise existing scum handling system for Primary Clarifiers No. 1, 2, and 3 inclusive of additional high strength waste receiving for anaerobic digestion
	PC-2	HSW and Septage Receiving at GT 1 Repurpose Gravity Thickener No. 1 to equalize loadings of high strength waste for anaerobic digestion
Activated Sludge	AS-1	A/S Reactor Splitter Box Add new primary effluent splitter box prior to the activated sludge reactors for improved biological stability and performance
	AS-2	Large Blade Submersible Selector Mixers Replace existing selector zone mixers with more efficient large blade submersible mixers
	AS-3	Modified UCT Revise existing unaerated selectors to the modified University of Cape Town (UCT) process for improved nutrient removal
	AS-4	Sec Clar Splitter Box Add new mixed liquor suspended solids splitter box prior to the secondary clarifiers for improved effluent quality when loaded uniformly
	AS-5b	Modify RAS Piping to Minimize Deposition Add new buried valves on the existing return activated sludge suction piping to facilitate system maintenance
	AS-6	Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal Future planning level cost for new secondary clarifier mechanisms with improved flocculating inlets and rapid sludge withdrawal
	AS-7	Sec Clar Density Current Baffles Add new density current baffles to existing secondary clarifiers for improved effluent TSS quality
Effluent Phosphorus Treatment	EP-1b	Outside-In Cloth Disk Filter with Coagulation Zones Add new right-sized, tertiary pumping system, chemical conditioning system for phosphorus precipitation, and disc filters prior to disinfection
	EP-2	Clarifier Launder Covers Add new secondary clarifier effluent launder covers to minimize algae growth prior to the tertiary disc filters
Disinfection	DI-1	Replacement UV System Future planning level cost for effluent ultraviolet disinfection system replacement when existing system reaches its end of useful life
Sludge Thickening	ST-1d	Separate WAS Sludge GBT and Struvite Control Add new gravity belt thickener system to provide WAS thickening to

Unit Process	Alternative	Description
		improve anaerobic digestion detention time. Piping will include the ability to process primary sludge for future phased digestion thickening needs.
Digester Operation, Heating, and Recirculation	D-2	TPAD Conversion Replace existing digester heating system with new boilers, heat exchangers, recirculation pumps, and heat loop to operate in a thermophilic/mesophilic temperature phased anaerobic digestion mode
Digester Mixing	DM-1	Digester 1&4 Draft Tube 2&3 Jet Mixing Add new digester mixing systems to each digester
Biosolids Reuse	BR-1d	Increase Diversity (30% Liquid 70% Dried Biosolid) Add new digested sludge dewatering equipment and low-temperature belt drying equipment with dried biosolids handling facilities. Capacity of new systems minimized with continued use of the existing liquid biosolids land application system
	BR-2	Improve Biosolids Quality Add new primary sludge screen to remove debris prior to thickening, digestion, and land application or drying
Biogas	BG-1	Replace Waste Gas Burner Replace existing biogas waste gas burner with larger capacity automatic flare for improved emissions control
	BG-3c	Peak Shaving Cogeneration Engine Add new 600kW biogas generator, biogas conditioning system, heat recovery loop, electrical distribution gear, and remote mounted biogas storage membrane
Site and Utilities	U-1	Replace Facility Wide Heating System Replace existing aging, independent, and inefficient house boilers with a facility wide heating system connected to the digester heat loop
	U-2	Comply with NFPA 820 & 10-State Stds for Buildings Replace existing ventilation systems, provide physical separation for hazardous areas, and modify electrical systems to comply with National Fire Protection Association (NFPA) 820 and State code for buildings
	U-3	Increase W3 System Capacity Revise existing non-potable effluent water pumps to increase system capacity for proposed systems
	U-4	New Transformers and One Electrical Service Replace existing electrical services, main distribution gear, conduits and conductors, and transformers to all facility motor control centers. Also replace and add key standby generators.
	U-5	Floodplain and Site Access Improvements Revise existing site entrance to provide improved flood control and revised pavement for hauler access

The total initial cost of this Package A is approximately \$56.6 million; with a 20-year total present worth of \$75.8 million.

Other Issues & Considerations

Other issues and factors could affect the overall implementation of improvements, or the selection of processes and technologies during the planning period. As a result the City should consider the recommended plan as a dynamic plan – and should periodically review and revise recommendations based on future conditions. Examples of future changes/issues/considerations that could affect the recommended plan include the items listed below.

- The system needs identified a future long-term concern with compliance of a total nitrogen limit that could occur due to a Mississippi River Total Maximum Daily Load (TMDL). An added benefit to Alternative AS-3 (convert from A2O to MUCT) was identified as the ability to optimize the facility for simultaneous nitrification-denitrification beyond the denitrification that is enabled in the dedicated anoxic zone. The ability to optimize for both total nitrogen, without sacrificing total phosphorus removal is unknown and should be trialed after startup.
- The capital costs for Alternative ST-1c and ST-1d (combined or separate sludge thickening) was identified to be equal; with only operational costs and performance as the distinguishing features. It was recommended to include separate raw sludge thickening; however, upon startup staff should consider full scale operation as a combined sludge prior to deciding which mode to operate. For example, the cost for additional polymer associated with combined sludge thickening could be offset by the tipping fee and additional biogas received by the ability to add more high strength wastes.
- The proposed end-users for dried biosolids may be capable of receiving truckloads of biosolids on a regular (daily or weekly) basis, such that the onsite silo capacity may be decrease, saving significant capital cost from the proposed concepts.
- Capacity required for industry growth and peaking factors. Industrial growth projections created prior to understanding future rate impacts. Recommend continued discussion with industries to confirm rate and extent of growth projections to recalculate projected flows and loadings and equipment sizes. It is anticipated that this sensitivity analysis may have a drastic impact on the biosolids handling and storage alternatives.
- Future changes to the volume of hauled-in waste received and added directly to digestion may significantly increase the quantity of sludge/biosolids for handling and reuse. The sizing of solids equipment will be based upon the design basis loadings; however each system should be re-evaluated upon determination of significant future loadings.
- Although specific unit processes were selected as an acceptable improvement fit for the City's needs, upon preliminary design of each respective alternative a re-assessment of available technologies should be performed. For example, screw press dewatering was selected as the preferred technology in the evaluation. However, if the City's (or other installations) current/future experiences with this dewatering technology prove undesirable, the City should reconsider the applicable technologies.
- Additional chemical phosphorus removal may be required to control sidestream struvite and maintain process stability. Should this dose become undesirable or unsustainable, the facility

should consider phosphorus recovery processes (e.g., Ostara) to provide further benefits. There currently are several available technologies for phosphorus removal; however, each of them are still in the developing stage and the available manufacturers and techniques should be reconsidered at that time.

- Land requirements at or near the WWTP are restrictive and the City has invested significant infrastructure to convey the wastewater to this location. Future City planning and site development should consider reserving space for long-term (50-100 year) WWTP replacement or expansion needs.
- The solids handling system was noted to be a limiting unit process to WWTP rated capacity. After construction of the proposed solids handling improvements, a re-rating of the facility would be recommended to identify the next limiting unit process and to pursue an increase to the facility's rated capacity.
- Electrical improvements related to standby generator replacements can be more cost effective if loads are merged on a new centralized standby generator(s) and electrical distribution switchgear.
- Since all work is primarily inside the fence and minimal new structures, no special construction methods were considered to mitigate for an endangered species or archeological item found in the area of construction. A preliminary environmental review is provided in Appendix C.

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

SUMMARY

INITIAL COST ESTIMATE

ALTERNATIVE NO. AND NAME	Initial Cost (\$)	Annual O&M (\$)	Present Worth of Annual O&M (\$)	Total Present Worth (\$)
Headworks/Preliminary Treatment				
H-1 Fine Screen	1,007,000	0	0	1,007,000
H-2 Grit System Programming	6,000	0	0	6,000
H-3 HVAC Replacement	258,000	0	0	258,000
H-4 Septage and Holding Receiving	1,541,000	0	0	1,541,000
Primary Clarification				
PC-1 Scum Pit 3 (Scum Pump) w/ HSW	623,000	0	0	623,000
PC-2 HSW and Septage Receiving at GT 1	490,000	0	0	490,000
Activated Sludge				
AS-1 A/S Reactor Splitter Box	353,000	0	0	353,000
AS-2 Large Blade Submersible Selector Mixers	355,000	-23,000	-324,000	31,000
AS-3 Modified UCT	1,089,000	-23,000	-324,000	765,000
AS-4 Sec Clar Splitter Box	936,000	0	0	936,000
AS-5a New Submersible RAS Pump Stations	1,168,000	0	0	1,168,000
AS-5b Modify RAS Piping to Minimize Deposition	224,000	0	0	224,000
AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal	1,600,000	0	0	1,600,000
AS-7 Sec Clar Density Current Baffles	315,000	0	0	315,000
Effluent Phosphorus Treatment				
EP-1a Inside-Out Cloth Disk Filter with Coagulation Zones	6,871,000	329,000	4,624,000	11,495,000
EP-1b Outside-In Cloth Disk Filter with Coagulation Zones	5,617,000	424,000	5,959,000	11,576,000
EP-1c Reactive Upflow Sand Filter	9,052,000	269,000	3,781,000	12,833,000
EP-2 Clarifier Launder Covers	627,000	0	0	627,000
Disinfection				
DI-1 Replacement UV System	1,919,000	0	0	1,919,000
Sludge Thickening				
ST-1a Combined Raw Sludge Disk Thickener	0	0	0	0
ST-1b Separate WAS Sludge Disk Thickener and Struvite Control	883,000	38,000	535,000	1,418,000
ST-1c Combined Raw Sludge GBT	858,000	48,000	675,000	1,533,000
ST-1d Separate WAS Sludge GBT and Struvite Control	648,000	37,000	520,000	1,168,000
ST-1e Combined Raw Sludge RDT	1,646,000	151,000	2,123,000	3,769,000
ST-1f Separate WAS Sludge RDT and Struvite Control	940,000	60,000	844,000	1,784,000
Digester Operation, Heating, and Recirculation				
D-1 Status Quo Mesophilic Digestion	3,486,000	0	0	3,486,000
D-2 TPAD Conversion	2,962,000	0	0	2,962,000
D-3 WAS Conditioning (Temperature and pH)	5,653,000	25,000	352,000	6,005,000
Digester Mixing				
DM-1 Digester 1&4 Draft Tube 2&3 Jet Mixing	1,637,000	60,000	844,000	2,481,000
Biosolids Reuse				
BR-1a Status Quo (80% Liquid 20% Cake to Land Application)	11,175,000	1,093,000	15,360,000	26,535,000
BR-1b 15%TS Liquid Handling (75% Liquid 25% Cake to Land Application)	12,348,000	823,000	11,566,000	23,914,000
BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)	11,526,000	1,094,000	15,374,000	26,900,000
BR-1cr Improve Logistics (Remote Cake Storage)	11,181,000	1,000,000	14,053,000	25,234,000
BR-1d Increase Diversity (30% Liquid 70% Dried Biosolids Belt Dryer, with Cake Optional)	19,526,000	536,000	7,533,000	27,059,000
BR-1e Increase Diversity (50% Liquid, 40% Cake, and 10% Dried Biosolids Solar)	13,729,000	983,000	13,815,000	27,544,000
BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)	26,235,000	556,000	7,814,000	34,049,000
BR-1g Increase Diversity (50% Liquid, 50% Cake, with 10% Cake to Compost)	0	0	0	0
BR-2 Improve Biosolids Quality (add Primary Sludge Screening)	1,122,000	0	0	1,122,000
Biogas				
BG-1 Replace Waste Gas Burner	374,000	0	0	374,000
BG-2 Biogas Storage	1,191,000	0	0	1,191,000
BG-3a Baseline Energy Consumption	0	618,000	8,685,000	8,685,000
BG-3b Cogeneration Engine	3,907,000	445,000	6,254,000	10,161,000
BG-3c Peak Shaving Cogeneration Engine	5,344,000	355,000	4,989,000	10,333,000
BG-3d Cogeneration Microturbine	3,929,000	467,000	6,563,000	10,492,000
BG-3e Pipeline to Utility	9,014,000	222,000	3,120,000	12,134,000
Site and Utilities				
U-1 Replace Facility Wide Heating System	605,000	0	0	605,000
U-2 Comply with NFPA 820 & 10-State Stds for Buildings	2,183,000	0	0	2,183,000
U-3 Increase W3 System Capacity	369,000	0	0	369,000
U-4 New Transformers and One Electrical Service	4,521,000	0	0	4,521,000
U-5 Floodplain and Site Access Improvements	361,000	0	0	361,000

City of La Crosse
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H-1 Fine Screen
INITIAL COST ESTIMATE

General Description

Add static overflow fine screen with auger to retain screenings in main channel to be captured in downstream existing step screen.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			26,000
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			2,000
New 1/4" Multi-Rake Bar Screen (20 mgd)	Each	1	322,000	322,000
Wash Press	Each	1	104,500	104,500
Demo Existing Comminutors	Lump Sum	1	4,000	4,000

Civil Not Listed Above	Lump Sum	1	10,000	10,000
Electrical Not Listed Above	Lump Sum	1	30,000	30,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				538,500
Contingency			30%	161,550
Subtotal				700,050
Contractor Overhead & Profit			25%	175,013
Total Construction Cost				875,063
Engineering			15%	131,259
Total Initial Cost				1,007,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

H-1 Fine Screen

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	Lump Sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork: Backfill	Lump Sum			
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds	10	1,000	10,000
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds	10	1,500	15,000
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Grout Infill	Lump Sum	1	1,000	1,000
Concrete				26,000
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals: Aluminum Hatch	Lump Sum	0	10,000	0
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition: Cut Concrete Walls	lump sum	1	2,000	2,000
Demolition:	lump sum			
Demolition				2,000

City of La Crosse
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H-2 Grit System Programming

INITIAL COST ESTIMATE

General Description

This project incorporates the time it will take to incorporate minor changes to the existing grit system. This includes problem identification, potential travel, and programming changes.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Identify Program Change Requirements	Hour	8	125	1,000
Develop Operational Strategy	Hour	2	125	250
Programing Changes	Hour	2	125	250
Trip (hours)	Hour	8	125	1,000
Trip (mileage)	Each	2	150	300

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				2,800
Contingency			30%	840
Subtotal				3,640
Contractor Overhead & Profit			25%	910
Total Construction Cost				4,550
Engineering			15%	683
Total Initial Cost				6,000

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H-2 Grit System Programming

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1		
Earthwork: Excavation	cu yds	1		
Earthwork: Underdrain System	sq yds	1		
Earthwork: Pile Foundation	ft	1		
Earthwork: Flood Protection Levee	cu yds	1		
Earthwork: Flood Protection Gravel Road	sq yds	1		
Earthwork:		1		
Earthwork				0
Concrete: Footings	cu yds	1		
Concrete: Base Slab	cu yds	1		
Concrete: Walls	cu yds	1		
Concrete: Floor Slabs	cu yds	1		
Concrete: Structural Slabs	cu yds	1		
Concrete: Columns	cu yds	1		
Concrete: Channels	cu yds	1		
Concrete: Precast Roof	ft	1		
Concrete				0
Metals: Aluminum Grating	sq ft	1		
Metals: Aluminum Handrail	ft	1		
Metals: Aluminum Stairway	risers	1		
Metals: Baffles and Weirs	sq ft	1		
Metals:		1		
Metals				0
Building:	sq ft	1		
Building:	sq ft	1		
Building:	sq ft	1		
Building:	sq ft	1		
Building:	sq ft	1		
Building:	sq ft	1		
Buildings				0
Demolition:	cu ft	1		
Demolition:	cu ft	1		
Demolition:	lump sum	1		
Demolition:	lump sum	1		
Demolition				0

City of La Crosse
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H-2 Grit System Programming

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	0
Brake Horsepower of Each Operating Pump	10
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
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H-3 HVAC Replacement

INITIAL COST ESTIMATE

General Description

This alternative is for the replacement of an air handling unit (AHU) at the administration/headworks facility. Note: additional upgrades necessary to upgrading the structure to NFPA 820 standards can be found in project U-2.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
 New AHU	Each	1	138,000	138,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				138,000
Contingency			30%	41,400
Subtotal				179,400
Contractor Overhead & Profit			25%	44,850
Total Construction Cost				224,250
Engineering			15%	33,638
Total Initial Cost				258,000

City of La Crosse
Wastewater Treatment Facilities Plan
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H-3 HVAC Replacement

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

H-3 HVAC Replacement

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	30
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

H-4 Septage and Holding Receiving

INITIAL COST ESTIMATE

General Description

This alternative is for the addition of a new septage building for introduction of septage at the plant headworks. This building will have a truck connection, fine screen, flowmeter, and 10,000 gal tank.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			13,400
Concrete	See Worksheet for Detailed Cost Breakdown			101,926
Metals	See Worksheet for Detailed Cost Breakdown			30,000
Buildings	See Worksheet for Detailed Cost Breakdown			160,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Septage Screen and Compactor	Lump Sum	1	320,000	320,000
Piping	Lump Sum	1	40,000	40,000

Civil Not Listed Above	Lump Sum	1	12,000	12,000
Electrical Not Listed Above	Lump Sum	1	77,000	77,000
Instrumentation and Control Not Listed Above	Lump Sum	1	39,000	39,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum	1	31,000	31,000

Subtotal				824,326
Contingency			30%	247,298
Subtotal				1,071,624
Contractor Overhead & Profit			25%	267,906
Total Construction Cost				1,339,530
Engineering			15%	200,929
Total Initial Cost				1,541,000

City of La Crosse
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H-4 Septage and Holding Receiving

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	800	16.75	13,400
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				13,400
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	30	400	11,852
Concrete: Walls	cu yds	62	1,200	74,667
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds	7	1,000	7,407
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	sq ft	800	10	8,000
Concrete				101,926
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals: Hoist	lump sum	1	10,000	10,000
Metals: Hatch	lump sum	1	20,000	20,000
Metals				30,000
Building: Septage (40' x 20')	sq ft	800	200	160,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				160,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

H-4 Septage and Holding Receiving

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	40
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

PC-1 Scum Pit 3 (Scum Pump) w/ HSW

INITIAL COST ESTIMATE

General Description

This project includes changes to the scum piping system of primary clarifiers No. 1-3 to allow for regular operation of these clarifiers without major operational concerns. This includes the change of the piping from CI to GL-DI, the creation of a new structure to decrease the amount of pipe that is gravity fed, and the addition of two pumps. In addition, this structure also incorporates a wet well for receiving HSW from the local area. The pumps force all scum and HSW to the digester

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			14,050
Concrete	See Worksheet for Detailed Cost Breakdown			99,854
Metals	See Worksheet for Detailed Cost Breakdown			17,050
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Scum/HSW Pumps	Each	2	20,000	40,000
GLDI Piping (6")	ft	450	94	42,255
Fittings	Lump Sum	1	8,350	8,350
Valves	Lump Sum	1	4,586	4,586

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	40,000	40,000
Instrumentation and Control Not Listed Above	Lump Sum	1	30,000	30,000
Plumbing Not Listed Above	Lump Sum	1	2,000	2,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				333,145
Contingency			30%	99,943
Subtotal				433,088
Contractor Overhead & Profit			25%	108,272
Total Construction Cost				541,360
Engineering			15%	81,204
Total Initial Cost				623,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

PC-1 Scum Pit 3 (Scum Pump) w/ HSW

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	200	20	4,000
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	600.00	16.75	10,050
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				14,050
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	22	400	8,889
Concrete: Walls	cu yds	73	1,000	73,481
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds	14	1,000	13,889
Concrete: Columns	cu yds	2	1,600	2,844
Concrete: Channels	cu yds			
Concrete: Precast Roof	sq ft	75	10	750
Concrete				99,854
Metals: Aluminum Grating	sq ft	30	35	1,050
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers	32	500	16,000
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				17,050
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

INITIAL COST ESTIMATE

General Description

This alternative is to convert the North gravity thickener (GT) for high strength waste (HSW). This offers potential savings by reusing existing pumps and piping to push wastes to the digesters.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			68,722
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Truck receiving System (pipe, valve pit, bar rake)	Lump Sum	1	50,000	50,000
High Build Coating	Lump Sum	1	30,000	30,000
Mixing System	Lump Sum	1	83,200	83,200

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	15,000	15,000
Instrumentation and Control Not Listed Above	Lump Sum	1	15,000	15,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				261,922
Contingency			30%	78,577
Subtotal				340,499
Contractor Overhead & Profit			25%	85,125
Total Construction Cost				425,624
Engineering			15%	63,844
Total Initial Cost				490,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals: Aluminum Geodesic Dome	sq ft	1,963	35	68,722
Metals				68,722
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	60
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-1 A/S Reactor Splitter Box

INITIAL COST ESTIMATE

General Description

This alternative is to modify an existing structure which intercepts primary effluent at the the west end of the aeration basins and construct a splitter box with weirs to split flow and reconnect to existing piping.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			5,193
Concrete	See Worksheet for Detailed Cost Breakdown			40,400
Metals	See Worksheet for Detailed Cost Breakdown			3,220
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Locally Operated Isolation Gates	Each	2	15,000	30,000
Piping (CL-DI, 30")	Lump Sum	1	30,000	30,000
Fittings	Lump Sum	1	30,000	30,000
Bypass Pumping	Lump Sum	1	50,000	50,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			
<hr style="border-top: 1px dashed black;"/>				
Subtotal				188,813
Contingency			30%	56,644
Subtotal				245,457
Contractor Overhead & Profit			25%	61,364
Total Construction Cost				306,821
Engineering			15%	46,023
Total Initial Cost				353,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-1 A/S Reactor Splitter Box

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	866	866
Earthwork: Excavation	cu yds	81	20	1,618
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft^2	162	16.75	2,710
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				5,193
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	6	400	2,400
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds	32	1,200	38,000
Concrete: Precast Roof	ft			
Concrete				40,400
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft	46	70	3,220
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				3,220
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-1 A/S Reactor Splitter Box

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	70
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

INITIAL COST ESTIMATE

General Description

This alternative shows the costs associated with converting the current submersible mixer assets to large blade submersibles. This will include installing more robust supports, purchase of the mixers, and installation. The number of mixers corresponds to the number needed for a conversion to modified UCT layout, and is not representative of a conversion under the current system.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork				0
Concrete				0
Metals				0
Buildings				0
Demolition				0
Large Blade Submersible Mixer	Each	4	33,833	135,332
Tripod	Each	4	5,769	23,076
Startup	Lump Sum	1	2,500	2,500
Freight	Lump Sum	1	9,000	9,000
Installation	Lump Sum	1	20,000	20,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				189,908
Contingency			30%	56,972
Subtotal				246,880
Contractor Overhead & Profit			25%	61,720
Total Construction Cost				308,601
Engineering			15%	46,290
Total Initial Cost				355,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	New	Existing
Number of Motors Operating	4.00	8.00
Brake Horsepower of Each Operating Motor	5.4	15.0
Total Bhp	22	120
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	100%	100%
Wire Horsepower	23	130
Wire Kilowatts	18	97
Operating Hours Per Day	24	12
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	4,368

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity (Savings)	Kw-hrs	-272,016	0.083	-22,577
Total Annual Cost				-23,000
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				-324,000

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

AS-3 Modified UCT

INITIAL COST ESTIMATE

General Description

This alternative involves modifying the BNR system from the A2O process to the Modified University of Cape Town (MUCT) Variation process. It involves extending the RAS piping to the beginning of the anoxic zones and relocating the existing ML recycle pumps to pump denitrified mixed liquor back to the beginning of the first anaerobic zones.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
9" Membrane Diffuser	Lump Sum	2,700	35	95,500
24" RAS Piping	Ft	460	300	138,000
Relocated Denitrified ML Recycle Pumps	Each	2	8,000	16,000
30" ML Recycle Piping	Each	240	350	84,000
Install	Lump Sum	1	100,000	100,000
Airflow Control Improvements	Lump Sum	1	89,000	89,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	15,000	15,000
Instrumentation and Control Not Listed Above	Lump Sum	1	45,000	45,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			
<hr style="border-top: 1px dashed black;"/>				
Subtotal				582,500
Contingency			30%	174,750
Subtotal				757,250
Contractor Overhead & Profit			25%	189,313
Total Construction Cost				946,563
Engineering			15%	141,984
Total Initial Cost				1,089,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-3 Modified UCT

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-3 Modified UCT

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	New	Existing
Number of Blowers Operating	2.00	2.00
Brake Horsepower of Each Operating Unit	157.5	175.0
Total Bhp	315	350
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	380	423
Wire Kilowatts	284	315
Operating Hours Per Day	24	24
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity (Savings)	Kw-hrs	-275,479	0.083	-22,865
Total Annual Cost				-23,000
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				-324,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-4 Sec Clar Splitter Box

INITIAL COST ESTIMATE

General Description

This alternative is for the addition of a new structure to more equally split ML flow between the final clarifiers.. This includes the new piping routed to the clarifiers, new locally controlled isolation gates, and installation of these new systems.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			24,658
Concrete	See Worksheet for Detailed Cost Breakdown			185,378
Metals	See Worksheet for Detailed Cost Breakdown			22,785
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			8,000
Locally Operated Isolation Gates (10')	Each	4	15,000	60,000
Install	Lump Sum	1	20,000	20,000
ML Piping (CL-DI, 36")	Lump Sum	1	150,000	150,000

Civil Not Listed Above	Lump Sum	1	25,000	25,000
Electrical Not Listed Above	Lump Sum	1	5,000	5,000
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				500,821
Contingency			30%	150,246
Subtotal				651,068
Contractor Overhead & Profit			25%	162,767
Total Construction Cost				813,834
Engineering			15%	122,075
Total Initial Cost				936,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-4 Sec Clar Splitter Box

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	4,110	4,110
Earthwork: Excavation	cu yds	482	20	9,644
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	651	16.75	10,904
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				24,658
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	72	400	28,933
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds	130	1,200	156,444
Concrete: Precast Roof	ft			
Concrete				185,378
Metals: Aluminum Grating	sq ft	651	35	22,785
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				22,785
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition existing piping	lump sum	1	8,000	8,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				8,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-4 Sec Clar Splitter Box

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
<u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5a New Submersible RAS Pump Stations

INITIAL COST ESTIMATE

General Description

This project is for the major reworking of the RAS pumping process. This includes the creation of four new RAS stations, one dedicated to each clarifier. Each pump would be submerged in a manhole and connections would make use of existing lines. Additional allowance is made for the inclusion of valve vault for pump isolation and metering.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			30,000
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			10,000
RAS Pumps	Each	4	39,000	156,000
Valves (1x check, 1x hand operated plug)	Each	4	24,700	98,800
20" Magmeter	Each	4	13,000	52,000
RAS Pump Manhole/Valve Vault	Each	4	39,000	156,000

Civil Not Listed Above	Lump Sum	1	56,000	56,000
Electrical Not Listed Above	Lump Sum	1	56,000	56,000
Instrumentation and Control Not Listed Above	Lump Sum	1	10,000	10,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				624,800
Contingency			30%	187,440
Subtotal				812,240
Contractor Overhead & Profit			25%	203,060
Total Construction Cost				1,015,300
Engineering			15%	152,295
Total Initial Cost				1,168,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5a New Submersible RAS Pump Stations

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	Per Manhole	4	5,000	20,000
Earthwork: Excavation	Per Manhole	4	2,500	10,000
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				30,000
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition: Existing Pumps	lump sum	1	10,000	10,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				10,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5a New Submersible RAS Pump Stations

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	0
Brake Horsepower of Each Operating Pump	35
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	3.5
Operating Weeks Per Year	52
Operating Hours Per Year	4,368

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

INITIAL COST ESTIMATE

General Description

This alternative is for the inclusion of isolation valves on the suction RAS lines emerging from each clarifier. These valves will allow for the clearing of blockages in the lines.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
20" Buried RAS Valve	Each	4	20,000	80,000
RAS Chlorination System	Lump Sum	1	35,000	35,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	2,500	2,500
Instrumentation and Control Not Listed Above	Lump Sum	1	1,500	1,500
Plumbing Not Listed Above	Lump Sum	1	500	500
HVAC Not Listed Above	Lump Sum			

Subtotal				119,500
Contingency			30%	35,850
Subtotal				155,350
Contractor Overhead & Profit			25%	38,838
Total Construction Cost				194,188
Engineering			15%	29,128
Total Initial Cost				224,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

INITIAL COST ESTIMATE

General Description

This alternative includes the modifications necessary to install Tow Bro sludge withdrawal mechanisms as well s FEDWA inlets. Together, these technologies help to ensure settling and prevent excessive disturbance of the sludge blanket.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Tow Brow/FEDWA	Each	4	209,000	836,000
Equipment	Lump Sum	1	10,000	10,000
Labor	Lump Sum	1	10,000	10,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				856,000
Contingency			30%	256,800
Subtotal				1,112,800
Contractor Overhead & Profit			25%	278,200
Total Construction Cost				1,391,000
Engineering			15%	208,650
Total Initial Cost				1,600,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

INITIAL COST ESTIMATE

General Description

This alternative is for the installation of density current baffles which prevent short circuiting within the clarifiers.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	0
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Density Current Baffles	Each	4	36,030	144,120
Install	Each	4	6,000	24,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				168,120
Contingency			30%	50,436
Subtotal				218,556
Contractor Overhead & Profit			25%	54,639
Total Construction Cost				273,195
Engineering			15%	40,979
Total Initial Cost				315,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1a Inside-Out Cloth Disk Filter with Coagulation Zones

INITIAL COST ESTIMATE

General Description

This alternative includes disc filters to bring effluent phosphorus down to future permit levels. This also includes the expected cost of storing the dosing chemicals and maintaining the system. System is located within the area of the chlorine contact tank.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork				20,912
Concrete				336,601
Metals				29,157
Buildings				460,349
Demolition				0
Disk Filter (firm capacity)	MGD	16	78,125	1,250,000
Disk Filter (redundancy)	MGD	8.0	78,125	625,000
Disk Filter Installation	Lump Sum	1	120,000	120,000
Pre-Filtration Pumping (5 MGD)	Each	4	45,000	180,000
Polymer Makedown and Dose System	Each	2	15,000	30,000
5000 Gallon Alum Storage Tank (1 month)	Each	1	15,000	15,000
Piping/Fittings (30", CL-DI)	Lump Sum	1	153,750	153,750
Valves	Per Filter	3	72,000	216,000
4'x4' Roof Hatch (pump access)	Each	4	2,500	10,000

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	80,000	80,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000

Subtotal				3,676,768
Contingency			30%	1,103,030
Subtotal				4,779,798
Contractor Overhead & Profit			25%	1,194,950
Total Construction Cost				5,974,748
Engineering			15%	896,212
Total Initial Cost				6,871,000

City of La Crosse

Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1a Inside-Out Cloth Disk Filter with Coagulation Zones

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	3,485	3,485
Earthwork: Excavation	cu yds	342	20	6,833
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft	632	16.75	10,594
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				20,912
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	23	400	9,370
Concrete: Walls	cu yds	244	1,200	292,446
Concrete: Floor Slabs	cu yds		1,000	0
Concrete: Structural Slabs	cu yds		1,000	0
Concrete: Columns	cu yds		1,600	0
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft	3,478	10	34,785
Concrete				336,601
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft	196	70	13,728
Metals: Aluminum Stairway	risers	31	500	15,429
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				29,157
Building: Over Disk Filters	sq ft	3,478	100	347,849
Building: Over Floc/Coag/Mix and Chem Struct	sq ft	750	150	112,500
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				460,349
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

EP-1a Inside-Out Cloth Disk Filter with Coagulation Zones

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Rapid Mix	Coag Mix	Floc Mix	Submersible pumps
Number of Pumps Operating	1	1	1	3
Brake Horsepower of Each Operating Pump	5.0	7.5	1.0	45.0
Total Bhp	5	8	1	135
Motor Efficiency	92%	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%	90%
Wire Horsepower	6	9	1	163
Wire Kilowatts	5	7	1	122
Operating Hours Per Day	24	24	24	24
Operating Days Per Week	7	7	7	7
Operating Weeks Per Year	52	52	52	52
Operating Hours Per Year	8,736	8,736	8,736	8,736

<u>General Description</u>	Backwash Pumps	Filter Rotate
Number of Pumps Operating	2	2
Brake Horsepower of Each Operating Pump	25.0	1.5
Total Bhp	50	3
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	60	4
Wire Kilowatts	45	3
Operating Hours Per Day	4	4
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,456	1,456

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	1,238,346	0.083	102,783
Ferric Chloride	Gal	169,875	1.17	198,753
Polymer	lb	21,931	1.21	26,536
Total Annual Cost				329,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	4,624,000
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1b Outside-In Cloth Disk Filter with Coagulation Zones

INITIAL COST ESTIMATE

General Description

This alternative includes cloth disk filters to bring effluent phosphorus down to future permit levels. This also includes the expected cost of storing the dosing chemicals and maintaining the system.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			34,920
Concrete	See Worksheet for Detailed Cost Breakdown			550,528
Metals	See Worksheet for Detailed Cost Breakdown			15,500
Buildings	See Worksheet for Detailed Cost Breakdown			180,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Disk Filter (firm capacity)	MGD	16	62,222	995,552
Disk Filter (redundancy)	MGD	8.0	62,222	497,776
Disk Filter Installation	Lump Sum	1	180,000	180,000
Pre-Filtration Pumping (5 MGD)	Each	4	45,000	180,000
Polymer Makedown and Dose System	Each	2	15,000	30,000
5000 Gallon Alum Storage Tank (1 month)	Each	1	15,000	15,000
Coag Mixer	Each	1	10,000	10,000
Inlet Gates w/ Electric Actuators	Each	3	22,000	66,000
4'x4' Roof Hatch (pump access)	Each	4	2,500	10,000

Civil Not Listed Above	Lump Sum	1	15,000	15,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	80,000	80,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000

Subtotal				3,005,276
Contingency			30%	901,583
Subtotal				3,906,859
Contractor Overhead & Profit			25%	976,715
Total Construction Cost				4,883,574
Engineering			15%	732,536
Total Initial Cost				5,617,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1b Outside-In Cloth Disk Filter with Coagulation Zones

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			5,820
Earthwork: Excavation	cu yds	450	20	9,000
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	1,200	16.75	20,100
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				34,920
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	14	400	5,600
Concrete: Walls	cu yds	380	1,200	456,240
Concrete: Floor Slabs	cu yds	22	1,000	22,330
Concrete: Structural Slabs	cu yds	25	1,000	25,000
Concrete: Columns	cu yds	22	1,600	34,608
Concrete: Channels	cu yds			
Concrete: Precast Roof	sq ft	675	10	6,750
Concrete				550,528
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers	31	500	15,500
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				15,500
Building: Filter Room, Backwash Pump Room	sq ft	1,200	150	180,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				180,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1b Outside-In Cloth Disk Filter with Coagulation Zones

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Rapid Mix	Coag Mix	Floc Mix	Submersible pumps
Number of Pumps Operating	1	1	1	3
Brake Horsepower of Each Operating Pump	15.0	2.0	2.0	45.0
Total Bhp	15	2	2	135
Motor Efficiency	92%	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%	90%
Wire Horsepower	18	2	2	163
Wire Kilowatts	14	2	2	122
Operating Hours Per Day	24	24	24	24
Operating Days Per Week	7	7	7	7
Operating Weeks Per Year	52	52	52	52
Operating Hours Per Year	8,736	8,736	8,736	8,736

<u>General Description</u>	Backwash Pumps	Filter Rotate
Number of Pumps Operating	2	2
Brake Horsepower of Each Operating Pump	20.0	2.0
Total Bhp	40	4
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	48	5
Wire Kilowatts	36	4
Operating Hours Per Day	4	4
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,456	1,456

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	1,269,829	0.083	105,396
Ferric Chloride	Gal	154,432	1.17	180,685
Polymer	lb	21,931	1.21	26,536
Replacement Media	sq ft	369	300.00	110,657
Total Annual Cost				424,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **5,959,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1c Reactive Upflow Sand Filter

INITIAL COST ESTIMATE

General Description

This alternative includes upflow reactive sand filters to bring effluent phosphorus down to future permit levels. This also includes the expected cost of storing the dosing chemicals and maintaining the system. System is located within the area of the chlorine contact tank.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			892,537
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			112,500
Demolition	See Worksheet for Detailed Cost Breakdown			0
Sand Filter (firm capacity)	MGD	16	177,891	2,846,250
Sand Filter (redundancy)	MGD	1.5	177,891	258,750
Sand Filter Installation	Lump Sum	1	215,000	215,000
Pre-Filtration Pumping (5 MGD)	Each	4	45,000	180,000
5000 Gallon Alum Storage Tank (1 month)	Each	1	15,000	15,000
12" Filter Isolation Valves	Each	21	1,800	37,800
Inlet Gates w/ Electric Actuators	Each	3	22,000	66,000
4'x4' Roof Hatch (pump access)	Each	4	2,500	10,000

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	80,000	80,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum	1	20,000	20,000

Subtotal				4,843,837
Contingency			30%	1,453,151
Subtotal				6,296,988
Contractor Overhead & Profit			25%	1,574,247
Total Construction Cost				7,871,235
Engineering			15%	1,180,685
Total Initial Cost				9,052,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1c Reactive Upflow Sand Filter

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	0	
Earthwork: Excavation	cu yds		20	0
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft		16.75	0
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	700	400	280,000
Concrete: Walls	cu yds	510	1,200	612,537
Concrete: Floor Slabs	cu yds		1,000	0
Concrete: Structural Slabs	cu yds		1,000	0
Concrete: Columns	cu yds		1,600	0
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft		10	0
Concrete				892,537
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft		70	0
Metals: Aluminum Stairway	risers		500	0
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Pumps/Chemicals	sq ft	750	150	112,500
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				112,500
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-1c Reactive Upflow Sand Filter

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Pre-Filt Pumps	Compressors
Number of Pumps Operating	3	1
Brake Horsepower of Each Operating Pump	45.0	60.0
Total Bhp	135	60
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	163	72
Wire Kilowatts	122	54
Operating Hours Per Day	24	24
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	1,062,563	0.083	88,193
Ferric Chloride	Gal	154,432	1.17	180,685
Total Annual Cost				269,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	3,781,000
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-2 Clarifier Launder Covers

INITIAL COST ESTIMATE

General Description

This alternative includes launder covers for the secondary clarifiers to prevent algal growth.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	0
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Launder Covers	Each	4	67,000	268,000
Labor	Each	4	16,750	67,000

Civil Not Listed Above	Lump Sum	0	0	
Electrical Not Listed Above	Lump Sum	0	0	
Instrumentation and Control Not Listed Above	Lump Sum	0	0	
Plumbing Not Listed Above	Lump Sum	0	0	
HVAC Not Listed Above	Lump Sum	0	0	

Subtotal				335,000
Contingency			30%	100,500
Subtotal				435,500
Contractor Overhead & Profit			25%	108,875
Total Construction Cost				544,375
Engineering			15%	81,656
Total Initial Cost				627,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-2 Clarifier Launder Covers

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

EP-2 Clarifier Launder Covers

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
<u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DI-1 Replacement UV System

INITIAL COST ESTIMATE

General Description

Replace vertical bulb system with horizontal bulb system.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			10,000
Horizontal Low Pressure High Output	Channel	3	338,800	1,016,400

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				1,026,400
Contingency			30%	307,920
Subtotal				1,334,320
Contractor Overhead & Profit			25%	333,580
Total Construction Cost				1,667,900
Engineering			15%	250,185
Total Initial Cost				1,919,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DI-1 Replacement UV System

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition: Existing UV	lump sum	1	10,000	10,000
Demolition:	lump sum			
Demolition				10,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DI-1 Replacement UV System

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Electricity: Lamps	Kw-hrs			0
Total Annual Cost				0
<u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1a Combined Raw Sludge Disk Thickener

INITIAL COST ESTIMATE

General Description

Not recommended by manufacturer

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost</u> <u>(\$)</u>	<u>Initial Cost</u> <u>(\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			
<hr style="border-top: 1px dashed black;"/>				
Subtotal				0
Contingency			30%	0
Subtotal				0
Contractor Overhead & Profit			25%	0
Total Construction Cost				0
Engineering			15%	0
Total Initial Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1a Combined Raw Sludge Disk Thickener

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1a Combined Raw Sludge Disk Thickener

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1b Separate WAS Sludge Disk Thickener and Struvite Control

INITIAL COST ESTIMATE

General Description

This alternative is to thicken the WAS to 5% TS prior to digestion on a disk thickener. Primary sludge would thicken separately in the south gravity thickener to 5% TS.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	2,000
Metals			See Worksheet for Detailed Cost Breakdown	20,000
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Twin Disk Thickener	Each	1	263,350	263,350
Thin Sludge Feed Pump/Meter	Each	0	20,000	0
Polymer Unit	Each	1	21,000	21,000
Thickened Sludge Pump	Each	1	16,000	16,000
Piping, Fittings, and Valves	Lump Sum	1	65,000	65,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	40,000	40,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				472,350
Contingency			30%	141,705
Subtotal				614,055
Contractor Overhead & Profit			25%	153,514
Total Construction Cost				767,569
Engineering			15%	115,135
Total Initial Cost				883,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1b Separate WAS Sludge Disk Thickener and Struvite Control

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	Lump Sum	1	2,000	2,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				2,000
Metals: Aluminum Grating and Platforms	Lump Sum	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1b Separate WAS Sludge Disk Thickener and Struvite Control

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	2	1
Brake Horsepower of Each Operating Pump	2.25	0.70
Total Bhp	5	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	5	1
Wire Kilowatts	4	1
Operating Hours Per Day	24	24
Operating Days Per Week	3	3
Operating Weeks Per Year	52	52
Operating Hours Per Year	3,844	3,844

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	17,766	0.083	1,475
Polymer	lb	22,995	1.21	27,824
Ferric Chloride	Gal	7,300	1.17	8,541
Total Annual Cost				38,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **535,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1c Combined Raw Sludge GBT

INITIAL COST ESTIMATE

General Description

This alternative is for the thickening of both primary sludge and WAS on a new GBT (2-meter) adjacent to the digested sludge GBT. This is expected to result in 7-9% TS on thickened sludge.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			2,000
Metals	See Worksheet for Detailed Cost Breakdown			20,000
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Gravity Belt Thickener (2-Meter)	Each	1	250,000	250,000
Thin Sludge Feed Pump/Meter	Each	0	20,000	0
Polymer Unit	Each	1	21,000	21,000
Thickened Sludge Pump	Each	1	16,000	16,000
Piping, Fittings, and Valves	Lump Sum	1	65,000	65,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	40,000	40,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				459,000
Contingency			30%	137,700
Subtotal				596,700
Contractor Overhead & Profit			25%	149,175
Total Construction Cost				745,875
Engineering			15%	111,881
Total Initial Cost				858,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1c Combined Raw Sludge GBT

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	Lump Sum	1	2,000	2,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				2,000
Metals: Aluminum Grating and Platforms	Lump Sum	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1c Combined Raw Sludge GBT

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	1	1
Brake Horsepower of Each Operating Pump	2	1.2
Total Bhp	2	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	2	1
Wire Kilowatts	2	1
Operating Hours Per Day	24	24
Operating Days Per Week	3	3
Operating Weeks Per Year	52	52
Operating Hours Per Year	3,162	3,162

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	8,776	0.083	728
Polymer	lb	38,892	1.21	47,059
Total Annual Cost				48,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **675,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

INITIAL COST ESTIMATE

General Description

This alternative is to thicken the WAS to 5% TS prior to digestion on a GBT. Primary sludge would thicken separately in the south gravity thickener to 5% TS.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	2,000
Metals			See Worksheet for Detailed Cost Breakdown	20,000
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Gravity Belt Thickener (1-Meter)	Each	1	175,000	175,000
Thin Sludge Feed Pump/Meter	Each	0	20,000	0
Polymer Unit	Each	1	13,650	13,650
Thickened Sludge Pump	Each	1	10,400	10,400
Piping, Fittings, and Valves	Lump Sum	1	48,750	48,750

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	36,000	36,000
Instrumentation and Control Not Listed Above	Lump Sum	1	36,000	36,000
Plumbing Not Listed Above	Lump Sum	1	4,500	4,500
HVAC Not Listed Above	Lump Sum			

Subtotal				346,300
Contingency			30%	103,890
Subtotal				450,190
Contractor Overhead & Profit			25%	112,548
Total Construction Cost				562,738
Engineering			15%	84,411
Total Initial Cost				648,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	Lump Sum	1	2,000	2,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				2,000
Metals: Aluminum Grating and Platforms	Lump Sum	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	1	1
Brake Horsepower of Each Operating Pump	2	1.2
Total Bhp	2	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	2	1
Wire Kilowatts	2	1
Operating Hours Per Day	24	24
Operating Days Per Week	2	2
Operating Weeks Per Year	52	52
Operating Hours Per Year	2,446	2,446

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	6,788	0.083	563
Polymer	lb	22,982	1.21	27,808
Ferric Chloride	Gal	7,300	1.17	8,541
Total Annual Cost				37,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **520,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1e Combined Raw Sludge RDT

INITIAL COST ESTIMATE

General Description

This alternative is for the thickening of both primary sludge and WAS on a new RDT adjacent to the digested sludge GBT. This is expected to result in 7-9% TS on thickened sludge.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			4,000
Metals	See Worksheet for Detailed Cost Breakdown			20,000
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Rotary Drum Thickener (2100 lb/hr each)	Each	2	283,750	567,500
Thin Sludge Feed Pump/Meter	Each	2	20,000	40,000
Polymer Unit	Each	2	21,000	42,000
Thickened Sludge Pump	Each	2	16,000	32,000
Piping, Fittings, and Valves	Lump Sum	1	90,000	90,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	40,000	40,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			
<hr style="border-top: 1px dashed black;"/>				
Subtotal				880,500
Contingency			30%	264,150
Subtotal				1,144,650
Contractor Overhead & Profit			25%	286,163
Total Construction Cost				1,430,813
Engineering			15%	214,622
Total Initial Cost				1,646,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1e Combined Raw Sludge RDT

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	Lump Sum	2	2,000	4,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				4,000
Metals: Aluminum Grating and Platforms	Lump Sum	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1e Combined Raw Sludge RDT

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	2	2
Brake Horsepower of Each Operating Pump	6	0.5
Total Bhp	11	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	13	1
Wire Kilowatts	10	1
Operating Hours Per Day	24	24
Operating Days Per Week	4	4
Operating Weeks Per Year	52	52
Operating Hours Per Year	5,329	5,329

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	57,134	0.083	4,742
Polymer	lb	120,689	1.21	146,034
Total Annual Cost				151,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **2,123,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1f Separate WAS Sludge RDT and Struvite Control

INITIAL COST ESTIMATE

General Description

This alternative is to thicken the WAS to 5% TS prior to digestion on a Rotary Drum Thickener. Primary sludge would thicken separately in the south gravity thickener to 5% TS.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			2,000
Metals	See Worksheet for Detailed Cost Breakdown			20,000
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Rotary Drum Thickener (2100 lb/hr)	Each	1	283,750	283,750
Thin Sludge Feed Pump/Meter	Each	1	20,000	20,000
Polymer Unit	Each	1	21,000	21,000
Thickened Sludge Pump	Each	1	16,000	16,000
Piping, Fittings, and Valves	Lump Sum	1	65,000	65,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	30,000	30,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				502,750
Contingency			30%	150,825
Subtotal				653,575
Contractor Overhead & Profit			25%	163,394
Total Construction Cost				816,969
Engineering			15%	122,545
Total Initial Cost				940,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1f Separate WAS Sludge RDT and Struvite Control

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	cu yds	1	2,000	2,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				2,000
Metals: Aluminum Grating and Platforms	sq ft	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

ST-1f Separate WAS Sludge RDT and Struvite Control

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	1	1
Brake Horsepower of Each Operating Pump	6	0.5
Total Bhp	6	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	7	1
Wire Kilowatts	5	0
Operating Hours Per Day	24	24
Operating Days Per Week	6	6
Operating Weeks Per Year	52	52
Operating Hours Per Year	6,989	6,989

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	37,465	0.083	3,110
Polymer	lb	39,551	1.21	47,857
Ferric Chloride	Gal	7,300	1.17	8,541
Total Annual Cost				60,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **844,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-1 Status Quo Mesophilic Digestion

INITIAL COST ESTIMATE

General Description

Construct new boilers, heat exchangers and pumps for all four digesters, and a new boiler building with heat exchangers in existing boiler room. Relocate recirculation pumps of Digesters No. 2 and 3 to a lower elevation for improved hydraulics. Also includes a liquid storage tank as a buffer prior to solids handling (0.7 MG).

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork				0
Concrete				0
Metals				20,000
Buildings				290,000
Demolition				10,000
Boilers	Each	2	140,000	280,000
Heat Exchangers	Each	4	90,000	360,000
Recirculation Pumps	Each	4	25,000	100,000
Sludge Piping	Lump Sum	1	80,000	80,000
Hot Water Piping and Pumps	Lump Sum	1	50,000	50,000
Liquid Storage Buffer Tank	Lump Sum	1	400,000	400,000

Civil Not Listed Above	Lump Sum	1	70,000	70,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	60,000	60,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				1,865,000
Contingency			30%	559,500
Subtotal				2,424,500
Contractor Overhead & Profit			25%	606,125
Total Construction Cost				3,030,625
Engineering			15%	454,594
Total Initial Cost				3,486,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-1 Status Quo Mesophilic Digestion

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	Lump Sum	1	20,000	20,000
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building: Boiler Room	sq ft	1,200	175	210,000
Building: Recirculation Pump Room	sq ft	400	200	80,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				290,000
Demolition: Remove Existing Boilers	lump sum	1	10,000	10,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				10,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-1 Status Quo Mesophilic Digestion

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	0
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

D-2 TPAD Conversion

INITIAL COST ESTIMATE

General Description

This alternative is similar to D-1, but the size of the boilers and heat exchangers has been increased for thermophilic temperatures. The increased capacity of TPAD frees up one digester to use as the liquid buffer prior to solids handling.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork				0
Concrete				0
Metals				20,000
Buildings				290,000
Demolition				10,000
Boilers	Each	2	160,000	320,000
Heat Exchangers	Each	4	90,000	360,000
Recirculation Pumps	Each	4	25,000	100,000
Sludge Piping	Lump Sum	1	80,000	80,000
Hot Water Piping and Pumps	Lump Sum	1	50,000	50,000
Sludge Cooling Heat Exchanger	Lump Sum	1	80,000	80,000

Civil Not Listed Above	Lump Sum	1	70,000	70,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	60,000	60,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				1,585,000
Contingency			30%	475,500
Subtotal				2,060,500
Contractor Overhead & Profit			25%	515,125
Total Construction Cost				2,575,625
Engineering			15%	386,344
Total Initial Cost				2,962,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-2 TPAD Conversion

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	Lump Sum	1	20,000	20,000
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft	1,200	175	210,000
Building:	sq ft	400	200	80,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				290,000
Demolition:	lump sum	1	10,000	10,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				10,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-2 TPAD Conversion

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	0
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-3 WAS Conditioning (Temperature and pH)

INITIAL COST ESTIMATE

General Description

This alternative is a modification of D-1 by inclusion of temperature, chemical, heat, and pressure cell lysis to increase digestion rate of WAS. These additional components are located in the dewatering building.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			20,000
Buildings	See Worksheet for Detailed Cost Breakdown			290,000
Demolition	See Worksheet for Detailed Cost Breakdown			10,000
TCHP Cell Lysis	Lump Sum	1	1,560,000	1,560,000
Boilers	Each	2	140,000	280,000
Heat Exchangers	Each	4	90,000	360,000
Recirculation Pumps	Each	4	25,000	100,000
Sludge Piping	Lump Sum	1	80,000	80,000
Hot Water Piping and Pumps	Lump Sum	1	50,000	50,000

Civil Not Listed Above	Lump Sum	1	70,000	70,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	60,000	60,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				3,025,000
Contingency			30%	907,500
Subtotal				3,932,500
Contractor Overhead & Profit			25%	983,125
Total Construction Cost				4,915,625
Engineering			15%	737,344
Total Initial Cost				5,653,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-3 WAS Conditioning (Temperature and pH)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	Lump Sum	1	20,000	20,000
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft	1,200	175	210,000
Building:	sq ft	400	200	80,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				290,000
Demolition:	lump sum	1	10,000	10,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				10,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

D-3 WAS Conditioning (Temperature and pH)

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	1
Brake Horsepower of Each Operating Pump	20
Total Bhp	20
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	24
Wire Kilowatts	18
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

Maintenance Hours Per Year

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	157,417	0.083	13,066
Maintenance	hours	0	35	0
NaOH	gal	18,250	0.625	11,406

Total Annual Cost **25,000**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **352,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DM-1 Digester 1&4 Draft Tube 2&3 Jet Mixing

INITIAL COST ESTIMATE

General Description

This alternative is for the construction of external draft tubes for mixing the two 74.5' diameter digesters and the construction of jet (pump & nozzle) mixing for two 65' diameter digesters.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			3,000
Concrete	See Worksheet for Detailed Cost Breakdown			8,000
Metals	See Worksheet for Detailed Cost Breakdown			1,120
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			8,000
Jet Mixing	Each	2	94,375	188,750
Jet Mixing - 30 hp VFD	Each	2	5,500	11,000
Jet Mixing - Piping	Lump Sum	1	26,000	26,000
10 hp Draft Tube Mixers (2 per digester)	Each	4	125,000	500,000

Civil Not Listed Above	Lump Sum	1	15,000	15,000
Electrical Not Listed Above	Lump Sum	1	70,000	70,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				875,870
Contingency			30%	262,761
Subtotal				1,138,631
Contractor Overhead & Profit			25%	284,658
Total Construction Cost				1,423,289
Engineering			15%	213,493
Total Initial Cost				1,637,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DM-1 Digester 1&4 Draft Tube 2&3 Jet Mixing

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	75	40	3,000
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				3,000
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	lump sum	2	4,000	8,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				8,000
Metals: Aluminum Grating	sq ft	32	35	1,120
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				1,120
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition: 2' x 2' Hole	Per Hole	4	2,000	8,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				8,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

DM-1 Digester 1&4 Draft Tube 2&3 Jet Mixing

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Jet Mixing	Draft Tube		
Number of Motors Operating	2	4		
Brake Horsepower of Each Operating Pump	28	8.7		
Total Bhp	56	35		
Motor Efficiency	92%	92%		
Adjustable Frequency Drive Efficiency	90%	90%		
Wire Horsepower	68	42		
Wire Kilowatts	50	31		
Operating Hours Per Day	24	24		
Operating Days Per Week	7	7		
Operating Weeks Per Year	52	52		
Operating Hours Per Year	8,736	8,736		
			Annual Quantity	Annual Cost (\$)
ITEM	Units		Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	714,672	0.083	59,318
Total Annual Cost				60,000
<u>Present Worth Analysis</u>				
Interest Rate Per Year	3.62500%			
Number of Years	20			
Present Worth Factor	14.053			
Present Worth of Total Annual Cost				844,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1a Status Quo (80% Liquid 20% Cake to Land Application)

INITIAL COST ESTIMATE

General Description

This option is for operating the plant in the same configuration as is current, with both liquid storage and cake storage increased proportionally to accommodate 330 days of storage.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			455,222
Concrete	See Worksheet for Detailed Cost Breakdown			756,470
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			691,040
Demolition	See Worksheet for Detailed Cost Breakdown			0
Liquid Sludge Storage Tanks Expansion (6.7 MG)	Lump Sum	1	3,076,715	3,076,715
Tank Mixing System	EA	3	250,000	750,000
Piping, Fittings, Valves	Lump Sum	1	80,000	80,000

Civil Not Listed Above	Lump Sum	1	30,000	30,000
Electrical Not Listed Above	Lump Sum	1	60,000	60,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	10,000	10,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				5,979,447
Contingency			30%	1,793,834
Subtotal				7,773,281
Contractor Overhead & Profit			25%	1,943,320
Total Construction Cost				9,716,601
Engineering			15%	1,457,490
Total Initial Cost				11,175,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1a Status Quo (80% Liquid 20% Cake to Land Application)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Cake Storage	ft	2,375	16.75	39,789
Earthwork: Pile Foundation - Liquid Storage	ft	23,309	16.75	390,433
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				455,222
Concrete: Base Slab - Cake Storage	cu yds	427	400	170,627
Concrete: Base Slab - Liquid Storage	cu yds	1,043	400	417,336
Concrete: Walls - Cake Storage	cu yds	140	1,200	168,507
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				756,470
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Cake Storage	sq ft	17,276	40	691,040
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				691,040
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1a Status Quo (80% Liquid 20% Cake to Land Application)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	BFP
Number of Motors Operating	1	1
Brake Horsepower of Each Operating Pump	15	35
Total Bhp	15	35
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	18	42
Wire Kilowatts	14	32
Operating Hours Per Day	24	24
Operating Days Per Week	1.6	0.8
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,948	1,048

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	59,385	0.083	4,929
Liquid Sludge Disposal	Gal	14,453,725	0.0605	874,450
Cake Disposal	Dry Ton	904	182	164,714
Polymer	Gal	39,790	1.21	48,146
Total Annual Cost				1,093,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	15,360,000
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1b 15%TS Liquid Handling (75% Liquid 25% Cake to Land Application)

INITIAL COST ESTIMATE

General Description

This alternative includes modifies modifications to the existing belt press discharge conveyors above the cake truck to enable cake conveyance to a Lystek cake hopper. Lystek hopper cake pump feeds the reactor where sludge is blended with a high pH and temperature to cause cell lysis. Final product is flowable 15% TS liquid. The GBT can also be reused for predigestion thickening.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			79,054
Concrete	See Worksheet for Detailed Cost Breakdown			480,936
Metals	See Worksheet for Detailed Cost Breakdown			50,000
Buildings	See Worksheet for Detailed Cost Breakdown			938,800
Demolition	See Worksheet for Detailed Cost Breakdown			112,500
GBT Credit (ST-1c)	Lump Sum	1	-459,000	-459,000
Lystek System (6 wet-ton/hr)	Lump Sum	1	2,500,000	2,500,000
Lystek Installation	Lump Sum	1	600,000	600,000
Cake Conveyors	ft	70	1,500	105,000
Biogas Conditioning	Each	1	200,000	200,000
Odor Control	Each	2	150,000	300,000
Tank Mixing System	Each	0	250,000	0

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	1,100,000	1,100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	400,000	400,000
Plumbing Not Listed Above	Lump Sum	1	60,000	60,000
HVAC Not Listed Above	Lump Sum	1	135,000	135,000

Subtotal				6,607,290
Contingency			30%	1,982,187
Subtotal				8,589,477
Contractor Overhead & Profit			25%	2,147,369
Total Construction Cost				10,736,846
Engineering			15%	1,610,527
Total Initial Cost				12,348,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1b 15%TS Liquid Handling (75% Liquid 25% Cake to Land Application)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Cake Storage	ft	3,227	16.75	54,054
Earthwork: Pile Foundation - Liquid Storage	ft		16.75	0
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				79,054
Concrete: Base Slab - Cake Storage	cu yds	580	400	231,802
Concrete: Base Slab - Liquid Storage	cu yds		400	0
Concrete: Walls - Cake Storage	cu yds	166	1,200	199,133
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	Lump Sum	1	50,000	50,000
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				480,936
Metals: Aluminum Grating	Lump Sum	1	50,000	50,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				50,000
Building: Cake Storage	sq ft	23,470	40	938,800
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				938,800
Demolition: Cut Floor	cu ft	225	500	112,500
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				112,500

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1b 15%TS Liquid Handling (75% Liquid 25% Cake to Land Application)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	BFP	Lystek Mixer
Number of Motors Operating	1	1
Brake Horsepower of Each Operating Pump	35	150
Total Bhp	35	150
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	42	181
Wire Kilowatts	32	135
Operating Hours Per Day	24	24
Operating Days Per Week	4.3	3.0
Operating Weeks Per Year	52	52
Operating Hours Per Year	5,329	3,744

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	674,025	0.083	55,944
Liquid Sludge Disposal	Gal	5,420,147	0.0605	327,919
Cake Disposal	Ton	1,130	182	205,892
Polymer	Gal	40,695	1.21	49,240
Alkali Dosing	lb	483,226	0.380	183,626
Fuel	Therms	65,043	0.650	42,278
Fuel (Biogas)	Therms	65,043	-0.650	-42,278
Total Annual Cost				823,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **11,566,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)

INITIAL COST ESTIMATE

General Description

This option is for maintaining dual solids handling trains; one liquid and one cake. Each train handles 50% of the load. To make this more viable, the dewatering equipment has been expanded as well as the cake storage and liquid storage facilities.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			259,819
Concrete	See Worksheet for Detailed Cost Breakdown			1,093,653
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			2,545,600
Demolition	See Worksheet for Detailed Cost Breakdown			0
Screw Press (800 lb/hr)	Each	2	462,500	925,000
Polymer System	Each	2	30,000	60,000
Liquid Sludge Storage Tanks Expansion (1.8 MG)	Lump Sum	1	828,994	828,994
Tank Mixing System	Each	1	250,000	250,000
Piping, Fittings, Valves	Lump Sum	1	68,000	68,000

Civil Not Listed Above	Lump Sum	1	25,500	25,500
Electrical Not Listed Above	Lump Sum	1	46,750	46,750
Instrumentation and Control Not Listed Above	Lump Sum	1	32,000	32,000
Plumbing Not Listed Above	Lump Sum	1	8,500	8,500
HVAC Not Listed Above	Lump Sum	1	23,800	23,800

Subtotal				6,167,615
Contingency			30%	1,850,284
Subtotal				8,017,899
Contractor Overhead & Profit			25%	2,004,475
Total Construction Cost				10,022,374
Engineering			15%	1,503,356
Total Initial Cost				11,526,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Cake Storage	ft	7,739	16.75	129,620
Earthwork: Pile Foundation - Liquid Storage	ft	6,281	16.75	105,199
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				259,819
Concrete: Base Slab - Cake Storage	cu yds	1,412	400	564,938
Concrete: Base Slab - Liquid Storage	cu yds	281	400	112,448
Concrete: Walls - Cake Storage	cu yds	347	1,200	416,267
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				1,093,653
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Cake Storage	sq ft	54,440	40	2,177,600
Building: Dewatering Building	sq ft	1,840	200	368,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				2,545,600
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1c Increase Cake Handling (50% Liquid 50% Cake to Land Application)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press
Number of Motors Operating	1	2
Brake Horsepower of Each Operating Pump	15	5.5
Total Bhp	15	11
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	18	13
Wire Kilowatts	14	10
Operating Hours Per Day	24	24
Operating Days Per Week	1.0	2.3
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,223	2,883

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	45,100	0.083	3,743
Liquid Sludge Disposal	Gal	9,033,578	0.0605	546,531
Cake Disposal	Ton	2,261	182	411,784
Polymer	Gal	108,519	1.2	131,308
Total Annual Cost				1,094,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	15,374,000
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1cr Improve Logistics (Remote Cake Storage)

INITIAL COST ESTIMATE

General Description

This option is similar to that presented in BR-1c, but differs in that the cake storage is expanded to allow 2 months of storage capacity off site in two separate facilities (Note: each facility has 1 month of storage).

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			236,251
Concrete	See Worksheet for Detailed Cost Breakdown			1,093,653
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			2,347,636
Demolition	See Worksheet for Detailed Cost Breakdown			0
Screw Press (800 lb/hr)	Each	2	462,500	925,000
Polymer System	Each	2	30,000	60,000
Liquid Sludge Storage Tanks Expansion (1.8 MG)	Lump Sum	1	828,994	828,994
Tank Mixing System	Each	1	250,000	250,000
Piping, Fittings, Valves	Lump Sum	1	68,000	68,000
Land	Acre	2	10,000	20,000

Civil Not Listed Above	Lump Sum	1	42,500	42,500
Electrical Not Listed Above	Lump Sum	1	46,750	46,750
Instrumentation and Control Not Listed Above	Lump Sum	1	32,000	32,000
Plumbing Not Listed Above	Lump Sum	1	8,500	8,500
HVAC Not Listed Above	Lump Sum	1	23,800	23,800

Subtotal				5,983,084
Contingency			30%	1,794,925
Subtotal				7,778,009
Contractor Overhead & Profit			25%	1,944,502
Total Construction Cost				9,722,512
Engineering			15%	1,458,377
Total Initial Cost				11,181,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1cr Improve Logistics (Remote Cake Storage)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Cake Storage (WWTP)	ft	6,332	16.75	106,053
Earthwork: Pile Foundation - Liquid Storage	ft	6,281	16.75	105,199
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				236,251
Concrete: Base Slab - Cake Storage	cu yds	1,412	400	564,938
Concrete: Base Slab - Liquid Storage	cu yds	281	400	112,448
Concrete: Walls - Cake Storage	cu yds	347	1,200	416,267
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				1,093,653
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Cake Storage	sq ft	44,542	40	1,781,673
Building: Cake Storage Minimal	sq ft	9,898	20	197,964
Building: Dewatering Building	sq ft	1,840	200	368,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				2,347,636
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1cr Improve Logistics (Remote Cake Storage)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press
Number of Pumps Operating	1	2
Brake Horsepower of Each Operating Pump	15	5.5
Total Bhp	15	11
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	18	13
Wire Kilowatts	14	10
Operating Hours Per Day	24	24
Operating Days Per Week	2.0	2.3
Operating Weeks Per Year	52	52
Operating Hours Per Year	2,446	2,883

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	61,629	0.083	5,115
Liquid Sludge Disposal	Gal	9,033,578	0.0605	546,531
Cake Disposal	Ton	2,261	140	316,757
Polymer	Gal	108,519	1.2	131,308
Total Annual Cost				1,000,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	14,053,000
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1d Increase Diversity (30% Liquid 70% Dried Biosolids Belt Dryer, with Cake Optional)

INITIAL COST ESTIMATE

General Description

In this alternative, post-digestion solids handling is completed via thickening 30% of the load with the existing GBT while dewatering and drying the other 70%.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	44,464
Concrete			See Worksheet for Detailed Cost Breakdown	58,914
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	1,173,400
Demolition			See Worksheet for Detailed Cost Breakdown	0
<hr/>				
Liquid Sludge Storage Tanks Expansion (0 MG)	Lump Sum	0	0	
Tank Mixing System	Lump Sum	0	250,000	0
Piping, Fittings, Valves	Lump Sum	1	0	
Polymer System	Each	2	30,000	
Screw Press (800 lb/hr)	Each	2	462,500	925,000
Low Temperature Dryer	Each	1	3,770,000	3,770,000
Dried Cake Silo	Lump Sum	1	2,023,566	2,023,566
Wet Cake Hopper	Lump Sum	1	200,000	200,000
<hr/>				
Civil Not Listed Above	Lump Sum	1	130,000	130,000
Electrical Not Listed Above	Lump Sum	1	985,000	985,000
Instrumentation and Control Not Listed Above	Lump Sum	1	590,000	590,000
Plumbing Not Listed Above	Lump Sum	1	220,000	220,000
HVAC Not Listed Above	Lump Sum	1	328,000	328,000
<hr/>				
Subtotal				10,448,344
Contingency			30%	3,134,503
Subtotal				13,582,847
Contractor Overhead & Profit			25%	3,395,712
Total Construction Cost				16,978,559
Engineering			15%	2,546,784
Total Initial Cost				19,526,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1d Increase Diversity (30% Liquid 70% Dried Biosolids Belt Dryer, with Cake Optional)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Dewatering/Drying	ft	6,238	16.75	104,485
Earthwork: Pile Foundation - Liquid Storage	ft	-5,076	16.75	-85,021
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				44,464
Concrete: Base Slab - Dewatering/Drying	cu yds	374	400	149,793
Concrete: Base Slab - Liquid Storage	cu yds	-227	400	-90,879
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				58,914
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building: Dewatering Building (reuse cake storage)	sq ft	1,840	10	18,400
Building: Drying Building	sq ft	7,700	150	1,155,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				1,173,400
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1d Increase Diversity (30% Liquid 70% Dried Biosolids Belt Dryer, with Cake Optional)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press	Dryer W3	Dryer
Number of Motors Operating	1	2	1	1
Brake Horsepower of Each Operating Pump	15	5.5	13.4	210.0
Total Bhp	15	11	13	210
Motor Efficiency	92%	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%	90%
Wire Horsepower	18	13	16	254
Wire Kilowatts	14	10	12	189
Operating Hours Per Day	24	24	24	24
Operating Days Per Week	0.6	3.2	3.8	3.8
Operating Weeks Per Year	52	52	52	52
Operating Hours Per Year	786	4,019	4,717	4,717

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	50,452	0.083	4,188
Electricity - Dryer	Kw-hrs	949,663	0.083	78,822
Liquid Sludge Disposal	Gal	2,890,800	0.0605	174,893
Dried Product Disposal	Dry Ton	3,165	35	110,875
Polymer	Gal	137,467	1.2	166,335
Fuel (biogas)	Therm	408,755	-0.65	-265,691
Fuel (natural gas)	Therm	408,755	0.65	265,691
Total Annual Cost				536,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **7,533,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1e Increase Diversity (50% Liquid, 40% Cake, and 10% Dried Biosolids Solar)

INITIAL COST ESTIMATE

General Description

This alternative modifies BR-1c to include a solar dryer for drying 10% annually of the biosolids cake up to 75% TS primarily in the March-October season. Class A potential with testing.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			231,288
Concrete	See Worksheet for Detailed Cost Breakdown			1,419,973
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			2,050,080
Demolition	See Worksheet for Detailed Cost Breakdown			0
Solar Dryer	Each	1	1,590,000	1,590,000
Screw Press (800 lb/hr)	Each	2	462,500	925,000
Polymer System	Each	2	30,000	60,000
Liquid Sludge Storage Tanks Expansion (1.8 MG)	Lump Sum	1	422,924	422,924
Tank Mixing System	Each	1	250,000	250,000
Piping, Fittings, Valves	Lump Sum	1	68,000	68,000

Civil Not Listed Above	Lump Sum	1	30,000	30,000
Electrical Not Listed Above	Lump Sum	1	190,000	190,000
Instrumentation and Control Not Listed Above	Lump Sum	1	72,000	72,000
Plumbing Not Listed Above	Lump Sum	1	9,000	9,000
HVAC Not Listed Above	Lump Sum	1	28,000	28,000

Subtotal				7,346,265
Contingency			30%	2,203,879
Subtotal				9,550,144
Contractor Overhead & Profit			25%	2,387,536
Total Construction Cost				11,937,680
Engineering			15%	1,790,652
Total Initial Cost				13,729,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1e Increase Diversity (50% Liquid, 40% Cake, and 10% Dried Biosolids Solar)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Cake Storage	ft	6,035	16.75	101,089
Earthwork: Pile Foundation - Liquid Storage	ft	6,281	16.75	105,199
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				231,288
Concrete: Base Slab - Cake Storage	cu yds	1,106	400	442,588
Concrete: Base Slab - Liquid Storage	cu yds	281	400	112,448
Concrete: Walls - Cake Storage	cu yds	278	1,200	333,680
Concrete: Base Slab - Solar	cu yds	1,088	400	435,258
Concrete: Walls - Solar	cu yds	80	1,200	96,000
Concrete: Columns	cu yds			
Concrete:	Lump Sum			
Concrete: Precast Roof	ft			
Concrete				1,419,973
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Cake Storage	sq ft	42,052	40	1,682,080
Building: Dewatering Building	sq ft	1,840	200	368,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				2,050,080
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1e Increase Diversity (50% Liquid, 40% Cake, and 10% Dried Biosolids Solar)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press	Solar HVAC
Number of Pumps Operating	1	2	4
Brake Horsepower of Each Operating Pump	15	5.5	20.0
Total Bhp	15	11	80
Motor Efficiency	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%
Wire Horsepower	18	13	97
Wire Kilowatts	14	10	72
Operating Hours Per Day	24	24	24
Operating Days Per Week	1.0	2.3	2.2
Operating Weeks Per Year	52	52	52
Operating Hours Per Year	1,223	2,883	2,683

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	238,498	0.083	19,795
Liquid Sludge Disposal	Gal	9,033,578	0.0605	546,531
Cake Disposal	Dry Ton	1,809	182	329,427
Dried Biosolids Disposal	Dry Ton	452	70	31,676
Polymer	Gal	45,216	1.2	54,712
Total Annual Cost				983,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **13,815,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)

INITIAL COST ESTIMATE

General Description

In this alternative, post-digestion solids handling is completed via thickening 50% of the load with the existing GBT while dewatering and drying the other 50%.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			166,338
Concrete	See Worksheet for Detailed Cost Breakdown			202,306
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			1,668,400
Demolition	See Worksheet for Detailed Cost Breakdown			0
Liquid Sludge Buffer Tank Credit (D-1 partial)	Lump Sum	1	-400,000	-400,000
Polymer System	Each	3	30,000	
Screw Press (800 lb/hr)	Each	3	462,500	1,387,500
Low Temperature Dryer	Each	2	3,020,000	6,040,000
Dried Cake Silo	Lump Sum	1	2,900,000	2,900,000
Wet Cake Hopper	Lump Sum	1	200,000	200,000
GBT Credit (ST-1c)	Lump Sum	1	-459,000	-459,000

Civil Not Listed Above	Lump Sum	1	130,000	130,000
Electrical Not Listed Above	Lump Sum	1	1,135,000	1,135,000
Instrumentation and Control Not Listed Above	Lump Sum	1	590,000	590,000
Plumbing Not Listed Above	Lump Sum	1	190,000	190,000
HVAC Not Listed Above	Lump Sum	1	288,000	288,000

Subtotal				14,038,544
Contingency			30%	4,211,563
Subtotal				18,250,108
Contractor Overhead & Profit			25%	4,562,527
Total Construction Cost				22,812,635
Engineering			15%	3,421,895
Total Initial Cost				26,235,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds	2,500	10	25,000
Earthwork: Pile Foundation - Dewatering/Drying	ft	8,438	16.75	141,338
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				166,338
Concrete: Base Slab - Dewatering/Drying	cu yds	506	400	202,306
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				202,306
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building: Dewatering Building (reuse cake storage)	sq ft	1,840	10	18,400
Building: Drying Building	sq ft	11,000	150	1,650,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				1,668,400
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1f Increase Diversity (100% Dried Biosolids, with Liquid or Cake Optional)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press	Dryer W3	Dryer
Number of Motors Operating	1	3	1	2
Brake Horsepower of Each Operating Pump	15	5.5	13.4	150.0
Total Bhp	15	17	13	300
Motor Efficiency	92%	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%	90%
Wire Horsepower	18	20	16	362
Wire Kilowatts	14	15	12	270
Operating Hours Per Day	24	24	24	24
Operating Days Per Week	0.0	2.2	2.7	2.7
Operating Weeks Per Year	52	52	52	52
Operating Hours Per Year	0	2,683	3,407	3,407

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	39,888	0.083	3,311
Electricity - Dryer	Kw-hrs	962,073	0.083	79,852
Liquid Sludge Disposal	Gal	0	0.0605	0
Dried Product Disposal	Dry Ton	4,522	35	158,378
Polymer	Gal	180,865	1.2	218,846
Fuel (biogas)	Therm	438,000	-0.65	-284,700
Fuel (biogas)	Therm	583,880	0.65	379,522
Total Annual Cost				556,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **7,814,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1g Increase Diversity (50% Liquid, 50% Cake, with 10% Cake to Compost)

INITIAL COST ESTIMATE

General Description

No feedback from compost facility

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				0
Contingency			30%	0
Subtotal				0
Contractor Overhead & Profit			25%	0
Total Construction Cost				0
Engineering			15%	0
Total Initial Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1g Increase Diversity (50% Liquid, 50% Cake, with 10% Cake to Compost)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft		16.75	0
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds		400	0
Concrete: Walls	cu yds		1,200	0
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft		40	0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-1g Increase Diversity (50% Liquid, 50% Cake, with 10% Cake to Compost)

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	GBT	Screw Press
Number of Pumps Operating		
Brake Horsepower of Each Operating Pump	15	5.5
Total Bhp	0	0
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	0	0
Wire Kilowatts	0	0
Operating Hours Per Day	24	24
Operating Days Per Week	1.3	2.2
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,591	2,683

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs		0.083	0
Liquid Sludge Disposal	Gal		0.0605	0
Cake Disposal	Ton		182	0
Polymer	Gal		1.2	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-2 Improve Biosolids Quality (add Primary Sludge Screening)

INITIAL COST ESTIMATE

General Description

This alternative allows for the removal of debris from the primary sludge. Unit would be mounted near Plant 2 building, and receive pumped primary sludge prior to the gravity thickener. Screened sludge would fall into the gravity thickener for further thickening and pumping to digestion or solids handling. Screenings are compacted to a dumpster

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork				19,263
Concrete				36,048
Metals				1,920
Buildings				160,000
Demolition				0
Huber Screen Press	Each	2	129,000	258,000

Civil Not Listed Above	Lump Sum	1	10,000	10,000
Electrical Not Listed Above	Lump Sum	1	30,000	30,000
Instrumentation and Control Not Listed Above	Lump Sum	1	50,000	50,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum	1	30,000	30,000

Subtotal				600,231
Contingency			30%	180,069
Subtotal				780,300
Contractor Overhead & Profit			25%	195,075
Total Construction Cost				975,375
Engineering			15%	146,306
Total Initial Cost				1,122,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-2 Improve Biosolids Quality (add Primary Sludge Screening)

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	1,150	16.75	19,263
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				19,263
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	43	400	17,037
Concrete: Walls	cu yds	6	1,200	7,511
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	sq ft	1,150	10	11,500
Concrete				36,048
Metals: Aluminum Grating	sq ft	48	40	1,920
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				1,920
Building:	sq ft	800	200	160,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				160,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BR-2 Improve Biosolids Quality (add Primary Sludge Screening)

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0
 <u>Present Worth Analysis</u>				
Interest Rate Per Year		3.62500%		
Number of Years		20		
Present Worth Factor		14.053		
Present Worth of Total Annual Cost				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-1 Replace Waste Gas Burner

INITIAL COST ESTIMATE

General Description

Replace the existing waste gas burner with a new higher capacity burner.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	30,000
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
8" Waste Gas Burner	Lump Sum	1	65,000	65,000
Installation	Lump Sum	1	10,000	10,000
Piping Modifications	Lump Sum	1	30,000	30,000
Gas Handling Equipment	Lump Sum	1	45,000	45,000

Civil Not Listed Above	Lump Sum	1	10,000	10,000
Electrical Not Listed Above	Lump Sum	1	5,000	5,000
Instrumentation and Control Not Listed Above	Lump Sum	1	5,000	5,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				200,000
Contingency			30%	60,000
Subtotal				260,000
Contractor Overhead & Profit			25%	65,000
Total Construction Cost				325,000
Engineering			15%	48,750
Total Initial Cost				374,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-1 Replace Waste Gas Burner

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pad)	Lump Sum	1	30,000	30,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				30,000
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-1 Replace Waste Gas Burner

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

Maintenance Hours Per Year

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-2 Biogas Storage

INITIAL COST ESTIMATE

General Description

This alternative is for construction of a new biogas storage membrane remotely mounted from the digester complex. Sizing provides 12-hour detention for peak shaving.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork		See Worksheet for Detailed Cost Breakdown		0
Concrete		See Worksheet for Detailed Cost Breakdown		8,250
Metals		See Worksheet for Detailed Cost Breakdown		0
Buildings		See Worksheet for Detailed Cost Breakdown		0
Demolition		See Worksheet for Detailed Cost Breakdown		0
Slab on Grade Membrane Storage (12 hr)	cf	100,000	5.5	550,629
Digester gas piping	lump sum	1	30,000	30,000

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	18,000	18,000
Instrumentation and Control Not Listed Above	Lump Sum	1	25,000	25,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				636,879
Contingency			30%	191,064
Subtotal				827,942
Contractor Overhead & Profit			25%	206,986
Total Construction Cost				1,034,928
Engineering			15%	155,239
Total Initial Cost				1,191,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-2 Biogas Storage

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	25	330	8,250
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				8,250
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-2 Biogas Storage

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	0
Brake Horsepower of Each Operating Pump	5
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

Maintenance Hours Per Year

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3a Baseline Energy Consumption

INITIAL COST ESTIMATE

General Description

Baseline condition

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				0
Contingency			30%	0
Subtotal				0
Contractor Overhead & Profit			25%	0
Total Construction Cost				0
Engineering			15%	0
Total Initial Cost				0

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3a Baseline Energy Consumption

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Gas Handling Room	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3a Baseline Energy Consumption

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	<u>Existing</u> <u>WWTP Loads</u>	<u>Proposed</u> <u>WWTP Loads</u>
Number of Facilities Operating	1	1
Brake Horsepower of Each Operating Motors		246
Total Bhp		246
Motor Efficiency		92%
Adjustable Frequency Drive Efficiency		90%
Wire Horsepower		298
Wire Kilowatts	630	222
Operating Hours Per Day	24	24
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Uptime	100%	100%
Operating Hours Per Year	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual</u> <u>Quantity</u>	<u>Unit Cost</u> <u>(\$)</u>	<u>Annual Cost</u> <u>(\$)</u>
Status Quo Electricity	Kw-hrs	5,503,680	0.083	456,805
Proposed Loads Electricity	Kw-hrs	1,939,000	0.083	160,937

Total Annual Cost **618,000**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **8,685,000**

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

BG-3b Cogeneration Engine

INITIAL COST ESTIMATE

General Description

This alternative is to construct a digester gas engine generator to convert digester gas energy into electric energy and recovered heat. Includes a new gas conditioning room and a containerized engine with connections to existing biogas, hot water, and electrical systems. New engine mounted near cold storage building north of digesters.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			59,722
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			135,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Engine-Generator (400 kW)	Each	1	538,462	538,462
Engine-Generator Install	Lump Sum	1	24,600	24,600
H2S Removal	Each	1	344,000	344,000
H2S Removal Installation	Lump Sum	1	77,500	77,500
Gas Conditioning W/ Siloxane	Each	1	442,000	442,000
Gas Conditioning W/ Siloxane Installation	Each	1	45,500	45,500
Gas Piping	Lump Sum	1	62,500	62,500
Water Piping	Lump Sum	1	50,000	50,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum	1	15,000	15,000
Electrical Not Listed Above	Lump Sum	1	173,000	173,000
Instrumentation and Control Not Listed Above	Lump Sum	1	68,000	68,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000
<hr style="border-top: 1px dashed black;"/>				
Subtotal				2,090,284
Contingency			30%	627,085
Subtotal				2,717,369
Contractor Overhead & Profit			25%	679,342
Total Construction Cost				3,396,711
Engineering			15%	509,507
Total Initial Cost				3,907,000

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3b Cogeneration Engine

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	199	300	59,722
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				59,722
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Gas Handling Room	sq ft	900	150	135,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				135,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

**Wastewater Treatment Facilities Plan
La Crosse, WI**

BG-3b Cogeneration Engine

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	<u>Existing WWTP Loads</u>	<u>Proposed WWTP Loads</u>	<u>Proposed Cogen</u>
Number of Facilities Operating	1	1	1
Brake Horsepower of Each Operating Pump		246	
Total Bhp		246	
Motor Efficiency		92%	
Adjustable Frequency Drive Efficiency		90%	
Wire Horsepower		298	
Wire Kilowatts	630	222	400
Operating Hours Per Day	24	24	24
Operating Days Per Week	7	7	7
Operating Weeks Per Year	52	52	52
Uptime	100%	100%	90%
Operating Hours Per Year	8,736	8,736	7,862

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Status Quo Electricity	Kw-hrs	5,503,680	0.083	456,805
Proposed Loads Electricity	Kw-hrs	1,939,000	0.083	160,937
Self-Serve Electricity	Kw-hrs	3,144,960	-0.083	-261,032
Exporting Electricity	Kw-hrs	0	-0.030	0
Maintenance	Kw-hrs	3,144,960	0.028	88,059
Natural Gas	therms	0	0.650	0
Total Annual Cost				445,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **6,254,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3c Peak Shaving Cogeneration Engine

INITIAL COST ESTIMATE

General Description

This alternative is for construction of a new biogas storage membrane remotely mounted from the digester complex. Sizing provides 12-hour detention for peak shaving of a new 600kW biogas engine and gas conditioning systems.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			8,250
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Slab on Grade Membrane Storage (12 hr)	cf	100,000	5.5	550,629
Digester gas piping	lump sum	1	30,000	30,000
Engine-Generator (600 kW)	Each	1	800,000	800,000
Engine-Generator Install	Lump Sum	1	24,600	24,600
H2S Removal	Each	1	354,000	354,000
H2S Removal Installation	Lump Sum	1	77,500	77,500
Gas Conditioning W/ Siloxane	Each	1	452,000	452,000
Gas Conditioning W/ Siloxane Installation	Each	1	45,500	45,500
Gas Piping	Lump Sum	1	125,000	125,000
Water Piping	Lump Sum	1	50,000	50,000

Civil Not Listed Above	Lump Sum	1	15,000	15,000
Electrical Not Listed Above	Lump Sum	1	204,000	204,000
Instrumentation and Control Not Listed Above	Lump Sum	1	68,000	68,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000

Subtotal				2,859,479
Contingency			30%	857,844
Subtotal				3,717,322
Contractor Overhead & Profit			25%	929,331
Total Construction Cost				4,646,653
Engineering			15%	696,998
Total Initial Cost				5,344,000

City of La Crosse
Wastewater Treatment Facilities Plan
 La Crosse, WI

BG-3c Peak Shaving Cogeneration Engine

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	25	330	8,250
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				8,250
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3c Peak Shaving Cogeneration Engine

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	<u>Existing WWTP Loads</u>	<u>Proposed WWTP Loads</u>	<u>Proposed Cogen</u>	<u>Proposed Cogen</u>
Number of Facilities Operating	1	1	1	1
Brake Horsepower of Each Operating Pump		246		
Total Bhp		246		
Motor Efficiency		92%		
Adjustable Frequency Drive Efficiency		90%		
Wire Horsepower		298		
Wire Kilowatts	630	222	600	400
Operating Hours Per Day	24	24	12	12
Operating Days Per Week	7	7	7	7
Operating Weeks Per Year	52	52	52	52
Uptime	100%	100%	90%	90%
Operating Hours Per Year	8,736	8,736	3,931	3,931

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Status Quo Electricity	Kw-hrs	5,503,680	0.083	456,805
Proposed Loads Electricity	Kw-hrs	1,939,000	0.083	160,937
Self-Serve Electricity (600 kW)	Kw-hrs	2,358,720	-0.103	-242,948
Self-Serve Electricity (400 kW)	Kw-hrs	1,572,480	-0.083	-130,516
Exporting Electricity	Kw-hrs	0	-0.030	0
Maintenance	Kw-hrs	3,931,200	0.028	110,074
Natural Gas	therms	0	0.650	0
Total Annual Cost				355,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **4,989,000**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3d Cogeneration Microturbine

INITIAL COST ESTIMATE

General Description

This alternative is to construct a digester gas microturbine generator to convert digester gas energy into electric energy and recovered heat. Includes a new gas conditioning room and two enclosed microturbines with connections to existing biogas, hot water, and electrical systems. New units mounted near cold storage building north of digesters.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			59,722
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			135,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Microturbine (200 kW)	Each	2	275,000	550,000
Microturbine Install	Lump Sum	1	25,000	25,000
H2S Removal	Each	1	344,000	344,000
H2S Removal Installation	Lump Sum	1	77,500	77,500
Gas Conditioning W/ Siloxane	Each	1	442,000	442,000
Gas Conditioning W/ Siloxane Installation	Each	1	45,500	45,500
Gas Piping	Lump Sum	1	62,500	62,500
Water Piping	Lump Sum	1	50,000	50,000

Civil Not Listed Above	Lump Sum	1	15,000	15,000
Electrical Not Listed Above	Lump Sum	1	173,000	173,000
Instrumentation and Control Not Listed Above	Lump Sum	1	68,000	68,000
Plumbing Not Listed Above	Lump Sum	1	15,000	15,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000

Subtotal				2,102,222
Contingency			30%	630,667
Subtotal				2,732,889
Contractor Overhead & Profit			25%	683,222
Total Construction Cost				3,416,111
Engineering			15%	512,417
Total Initial Cost				3,929,000

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3d Cogeneration Microturbine

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	199	300	59,722
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				59,722
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Gas Handling Room	sq ft	900	150	135,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				135,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3d Cogeneration Microturbine

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	<u>Existing</u> <u>WWTP Loads</u>	<u>Proposed</u> <u>WWTP Loads</u>	<u>Proposed</u> <u>Cogen</u>
Number of Facilities Operating	1	1	1
Brake Horsepower of Each Operating Pump		246	
Total Bhp		246	
Motor Efficiency		92%	
Adjustable Frequency Drive Efficiency		90%	
Wire Horsepower		298	
Wire Kilowatts	630	222	308
Operating Hours Per Day	24	24	24
Operating Days Per Week	7	7	7
Operating Weeks Per Year	52	52	52
Uptime	100%	100%	95%
Operating Hours Per Year	8,736	8,736	8,299

<u>ITEM</u>	<u>Units</u>	<u>Annual</u> <u>Quantity</u>	<u>Unit Cost</u> <u>(\$)</u>	<u>Annual Cost</u> <u>(\$)</u>
Status Quo Electricity	Kw-hrs	5,503,680	0.083	456,805
Proposed Loads Electricity	Kw-hrs	1,939,000	0.083	160,937
Self-Serve Electricity	Kw-hrs	2,556,154	-0.083	-212,161
Exporting Electricity	Kw-hrs	0	-0.030	0
Maintenance / Replacement Fund	Kw-hrs	2,556,154	0.020	51,123
Natural Gas	therms	15,000	0.650	9,750
Total Annual Cost				467,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **6,563,000**

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

BG-3e Pipeline to Utility

INITIAL COST ESTIMATE

General Description

Condition and compress biogas, convey to nearest transmission line, and inject to main line. Renewable credits generated based on the sale of renewable vehicle fuel by consumers. Xcel services local natural gas, however Northern Gas owns the nearest interstate transmission line; which crosses the river at Barron Island

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			240,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Gas Conditioning System (Sulfur, Siloxanes, CO2)	Lump Sum	1	1,739,130	1,739,130
Gas Compression and Injection System (+/-1000 psi)	Lump Sum	1	1,304,348	1,304,348
Transmission Line to Barron Island	Lump Sum	1	1,200,000	1,200,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum	1	60,000	60,000
Electrical Not Listed Above	Lump Sum	1	150,000	150,000
Instrumentation and Control Not Listed Above	Lump Sum	1	80,000	80,000
Plumbing Not Listed Above	Lump Sum	1	10,000	10,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000
<hr style="border-top: 1px dashed black;"/>				
Subtotal				4,823,478
Contingency			30%	1,447,043
Subtotal				6,270,522
Contractor Overhead & Profit			25%	1,567,630
Total Construction Cost				7,838,152
Engineering			15%	1,175,723
Total Initial Cost				9,014,000

Wastewater Treatment Facilities Plan
La Crosse, WI

BG-3e Pipeline to Utility

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building: Gas Room	sq ft	1,200	200	240,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				240,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

**Wastewater Treatment Facilities Plan
La Crosse, WI**

BG-3e Pipeline to Utility

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	<u>Existing WWTP Loads</u>	<u>Proposed WWTP Loads</u>	<u>Proposed CNG Loads</u>
Number of Facilities Operating	1	1	1
Brake Horsepower of Each Operating Pump		246	100
Total Bhp		246	100
Motor Efficiency		92%	92%
Adjustable Frequency Drive Efficiency		90%	90%
Wire Horsepower		298	121
Wire Kilowatts	630	222	90
Operating Hours Per Day	24	24	24
Operating Days Per Week	7	7	7
Operating Weeks Per Year	52	52	52
Uptime	100%	100%	100%
Operating Hours Per Year	8,736	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Status Quo Electricity	Kw-hrs	5,503,680	0.083	456,805
Proposed Loads Electricity	Kw-hrs	1,939,000	0.083	160,937
Natural Gas for Heating	MMBtu	17,520	0.65	11,388
Electricity	Kw-hrs	787,084	0.083	65,328
D3 RIN Sales	MMBtu	31,536	-15	-473,040
D5 RIN Sales	MMBtu	0	-5	0
Total Annual Cost	YR 0-5 only			222,000
Total Annual Cost YR 5-20				537,360

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **3,120,000**

Conservative Estimate If RIN Pricing Decreases	
Present Worth of YR 0-5	1,242,000
Present Worth of YR 5-20	6,751,000
Conservative Present Worth of Total Annual Cost	7,993,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-1 Replace Facility Wide Heating System

INITIAL COST ESTIMATE

General Description

Construct a new central boiler system and facility heating system, providing the heat for the digestion process and the buildings. Boilers shall use digester gas with backup natural gas. This estimate includes costs for high efficiency, natural gas stand -by boilers to serve as back-ups to the digester gas fired boilers, it is assumed that either D-1 or D-2 is selected with this alternate that includes costs for the digester gas boilers. No HVAC heating equipment included in this costs, it is assumed that the digesters will only be capable of heating the digester and dewatering buildings, costs for that equipment in U-2.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost</u> <u>(\$)</u>	<u>Initial Cost</u> <u>(\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Boilers	Each	2	60,000	120,000
Pumps and Piping	Lump Sum	1	25,000	25,000
Building Interconnecting Piping	Lump Sum	1	35,000	35,000
Remote Building Piping	Lump Sum	1	60,000	60,000

Civil Not Listed Above	Lump Sum	1	16,000	16,000
Electrical Not Listed Above	Lump Sum	1	29,000	29,000
Instrumentation and Control Not Listed Above	Lump Sum	1	16,000	16,000
Plumbing Not Listed Above	Lump Sum	1	6,500	6,500
HVAC Not Listed Above	Lump Sum	1	16,000	16,000

Subtotal				323,500
Contingency			30%	97,050
Subtotal				420,550
Contractor Overhead & Profit			25%	105,138
Total Construction Cost				525,688
Engineering			15%	78,853
Total Initial Cost				605,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-1 Replace Facility Wide Heating System

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-1 Replace Facility Wide Heating System

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

Maintenance Hours Per Year

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-2 Comply with NFPA 820 & 10-State Stds for Buildings

INITIAL COST ESTIMATE

General Description

Bring existing structures up to code to improve safety, equipment longevity, and enable modifications to electrical and controls

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
<u>Admin Building</u>				
Ventilation for Dry Wells	Lump Sum	1	42,000	42,000
Stairway Access	Lump Sum	2	118,000	236,000
Replace RWW Pumps w/ Dry Pit Submersible	Each	5	53,000	265,000
Seperation of Clarifier Inlet Channel Area	Lump Sum	1	18,000	18,000
<u>Primary Effluent Pump Station</u>				
Ventilation Upgrades	Lump Sum	1	67,000	67,000
Seperation of Blower Room	Lump Sum	1	2,000	2,000
Seperation of Sludge Well	Lump Sum	1	13,000	13,000
<u>Dewatering Building</u>				
Ventilation Upgrades	Lump Sum	1	338,000	338,000
<u>Digester Building</u>				
Ventilation Upgrades	Lump Sum	1	67,000	67,000
Gas Handling Room	Sq Ft	200	300	60,000
DG Piping	Lump Sum	1	11,000	11,000
<u>Liquid Sludge Storage Building</u>				
Ventilation Upgrades	Lump Sum	1	49,000	49,000
Subtotal				1,168,000
Contingency			30%	350,400
Subtotal				1,518,400
Contractor Overhead & Profit			25%	379,600
Total Construction Cost				1,898,000
Engineering			15%	284,700
Total Initial Cost				2,183,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-2 Comply with NFPA 820 & 10-State Stds for Buildings

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-2 Comply with NFPA 820 & 10-State Stds for Buildings

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-3 Increase W3 System Capacity

INITIAL COST ESTIMATE

General Description

Provide additional W3 pumps to satisfy non-potable water demand when operating multiple mechanical sludge handling (thickening/dewatering) equipment.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
150 gpm Non-Potable Pump	Each	2	30,000	60,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	120,000	120,000
Instrumentation and Control Not Listed Above	Lump Sum	1	12,000	12,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				197,000
Contingency			30%	59,100
Subtotal				256,100
Contractor Overhead & Profit			25%	64,025
Total Construction Cost				320,125
Engineering			15%	48,019
Total Initial Cost				369,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-3 Increase W3 System Capacity

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-3 Increase W3 System Capacity

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

Maintenance Hours Per Year

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

**City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI**

U-4 New Transformers and One Electrical Service

INITIAL COST ESTIMATE

General Description

Provide new primary metering and switchgear from utility with increased redundancy for improved maintenance and reliability. New main power distribution gear will backfeed new 13.8kV transformers to step power down at all existing transformers to 480V.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
13.8kV SWGR, 4 sections	Each	1	100,000	100,000
Wiring from SWGR to Indoor Main	Lump Sum	1	20,000	20,000
13.8kV Indoor Main Distribution Board, 6 sections	Each	1	500,000	500,000
13.8kV:480V TFMR @ Plant 1, 1000kVa	Each	1	60,000	60,000
Wiring from Main to TFMR	ft	500	450	225,000
13.8kV:480V TFMR @ Plant 2, 1000kVa	Each	1	60,000	60,000
Wiring from Main to TFMR	ft	25	450	11,250
13.8kV:480V TFMR @ Sludge, 500kVa	Each	1	37,500	37,500
Wiring from Main to TFMR	ft	700	360	252,000
13.8kV:480V TFMR @ UV, 300kVa	Each	1	30,000	30,000
Wiring from Main to TFMR	ft	200	216	43,200
13.8kV:480V TFMR @ Cogen, 750kVa	Each	0	52,500	0
Wiring from Main to TFMR	ft	0	380	0
Standby Generator (Plant 1 400kW replacement)	Lump Sum	1	285,000	285,000
Standby Generator (Plant 2 400kW replacement)	Lump Sum	1	285,000	285,000
Standby Generator (HSi Blowers 800kW+ new)	Lump Sum	1	510,000	510,000
<hr style="border-top: 1px dashed black;"/>				
Subtotal				2,418,950
Contingency			30%	725,685
Subtotal				3,144,635
Contractor Overhead & Profit			25%	786,159
Total Construction Cost				3,930,794
Engineering			15%	589,619
Total Initial Cost				4,521,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-4 New Transformers and One Electrical Service

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-4 New Transformers and One Electrical Service

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-5 Floodplain and Site Access Improvements

INITIAL COST ESTIMATE

General Description

Install a flood control gate on the northwest plant entrance to prevent high river stages from entering the facility. Consideration could be given to an elevated entrance (graded) if topo survey data confirms feasibility.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
New Floodgate	Each	1	35,000	35,000
Berm Structural Modifications	Lump Sum	1	10,000	10,000
Revise site roadways for improved truck traffic	sf	8,800	10	88,000
H2S Control for La Crescent Forcemain	Lump Sum	1	60,000	60,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				193,000
Contingency			30%	57,900
Subtotal				250,900
Contractor Overhead & Profit			25%	62,725
Total Construction Cost				313,625
Engineering			15%	47,044
Total Initial Cost				361,000

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-5 Floodplain and Site Access Improvements

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse
Wastewater Treatment Facilities Plan
La Crosse, WI

U-5 Floodplain and Site Access Improvements

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736
Maintenance Hours Per Year	

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Maintenance	hours	0	35	0

Total Annual Cost **0**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **0**



City of La Crosse
Sanitary Sewer Utility
905 Houska Park Drive | La Crosse, WI, 54601

City of La Crosse Sanitary Sewer Utility Preliminary Phosphorus Compliance Plan

December 2018



Prepared by:

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Donohue Project No.: 12947

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ABBREVIATIONS

A2O	Anaerobic Aerobic Oxidation
Bio-P	Enhanced Biological Phosphorus Removal
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAFO	Confined Animal Feedlot Operation
EBPR	Enhanced Biological Phosphorus Removal
FCAP	Final Compliance Alternatives Plan
mg/L	milligrams/liter
MGD	Million Gallons per Day
MDV	Multi-Discharger Variance
MHI	Mean Household Income
MS4	Municipal Separate Storm Sewer System
MUCT	Modified University of Cape Town
O&M	Operations and Maintenance
PCAP	Preliminary Compliance Alternatives Plan
PP	Particulate Phosphorus
ppd	Pounds per Day
SP	Soluble Phosphorus
SRP	Soluble Reactive Phosphorus
TP	Total Phosphorus
TPW	Total Present Worth
US EPA	United States Environmental Protection Agency
WAS	Waste Activated Sludge
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System
WQBEL	Water Quality Based Effluent Limit
WWTP	Wastewater Treatment Plant

CHAPTER 1 - EXECUTIVE SUMMARY

The City of La Crosse evaluated a number of alternative approaches to complying with its future Water Quality Based Effluent Limits (WQBELs) for phosphorus. These limits include a monthly average of 0.300 mg/L and a 6 month average of 0.100 mg/L. These WQBELs are both significantly lower than the current interim limit of 1.0 mg/L. The existing wastewater treatment plant (WWTP) is capable of reliable compliance with the interim limit but not capable of meeting the future WQBELs on a consistent, reliable basis.

As part of its phosphorus compliance schedule the City is required to submit a Preliminary Compliance Alternatives Plan (PCAP) on or before January 1, 2019 and a Final Compliance Alternatives Plan (FCAP) on or before January 1, 2020. This report is intended to serve as the PCAP.

Alternatives considered for compliance with the future WQBELs included:

- Advanced Treatment through constructed modifications at the WWTP
- Adaptive Management
- Water Quality Trading
- Variance

A preliminary screening resulted in retaining seven advanced treatment options for further development and evaluation. The estimated costs, expressed as both Initial Cost and a Total Present Worth (TPW) Basis, for these alternatives are summarized in Table 1-1.

Table 1-1 Phosphorus Alternative Total Present Worth Estimated Costs

Alternative	Initial Cost (\$)	Annual O&M Cost (\$/yr)	TPW of Annual O&M (\$)	Total Present Worth (\$)
Alt 1 Optimize Activated Sludge & Upgrade SCADA	3,783,000	-23,000	-324,000	3,459,000
Alt 3 Optimize BNR Activated Sludge by Converting A2O System to MUCT System	1,089,000	-23,000	-324,000	765,000
Alt 7 Install Effluent Filtration Plus Enhanced Chemical Feed Facilities	7,498,000	329,000	4,624,000	12,122,000
Alt 8 Install Separate WAS Thickening/Continue Gravity Thickening Primary Sludge	858,000	25,000	352,000	1,210,000
Alt 9 Install Sidestream Struvite Harvesting System	6,561,000	-206,000	-2,895,000	3,666,000

Alt 11 Add Storage Tank at WWTP to Feed HSW to BNR System or Digesters	306,000	0	0	306,000
Alt 16 Investigate MS4 Trading with La Crosse and/or Onalaska	N/A	N/A	N/A	N/A

For the purposes of this Preliminary Compliance Alternatives Plan alternatives 1, 3, 7, 8, and 11 have been selected as the preferred suite of alternatives to maximize compliance. In the next 12 months, however, prior to submitting the Final Compliance Alternatives Plan, the City intends to further investigate MS4 trading as part of a side activity that may alleviate the operational demands of the recommended project.

CHAPTER 2 - BACKGROUND

2.1 EXISTING FACILITY

The Sanitary Sewer Utility for the City of La Crosse operates the Isle La Plume Wastewater Treatment Plant (WWTP). This WWTP is a regional wastewater treatment facility with an average day design flow of 20 MGD. The plant receives wastewater from the City of La Crosse and surrounding areas in Minnesota and Wisconsin, including the City of Onalaska, WI, the City of La Crescent, MN, the Town of Campbell, WI, and two sanitary districts that include parts of the Town of Shelby, WI.

Figure 1 presents a process flow diagram of the plant. The liquid treatment train consists of fine screening, grit removal, primary settling, nitrifying activated sludge configured in the anaerobic/anoxic/oxic (A2O) process configuration to achieve biological phosphorus removal (Bio-P), secondary settling, and ultraviolet disinfection. The solids handling treatment train consists of co-thickening of primary sludge and waste activated sludge (WAS) in gravity thickeners, and anaerobic digestion. The digested sludge, termed biosolids, are thickened using gravity belt thickeners or dewatered using a belt filter press. Liquid and dewatered biosolids are stored onsite prior to being recycled on agricultural land. The other residual material produced at the plant, from raw wastewater screening and grit removal, is disposed of by landfilling.

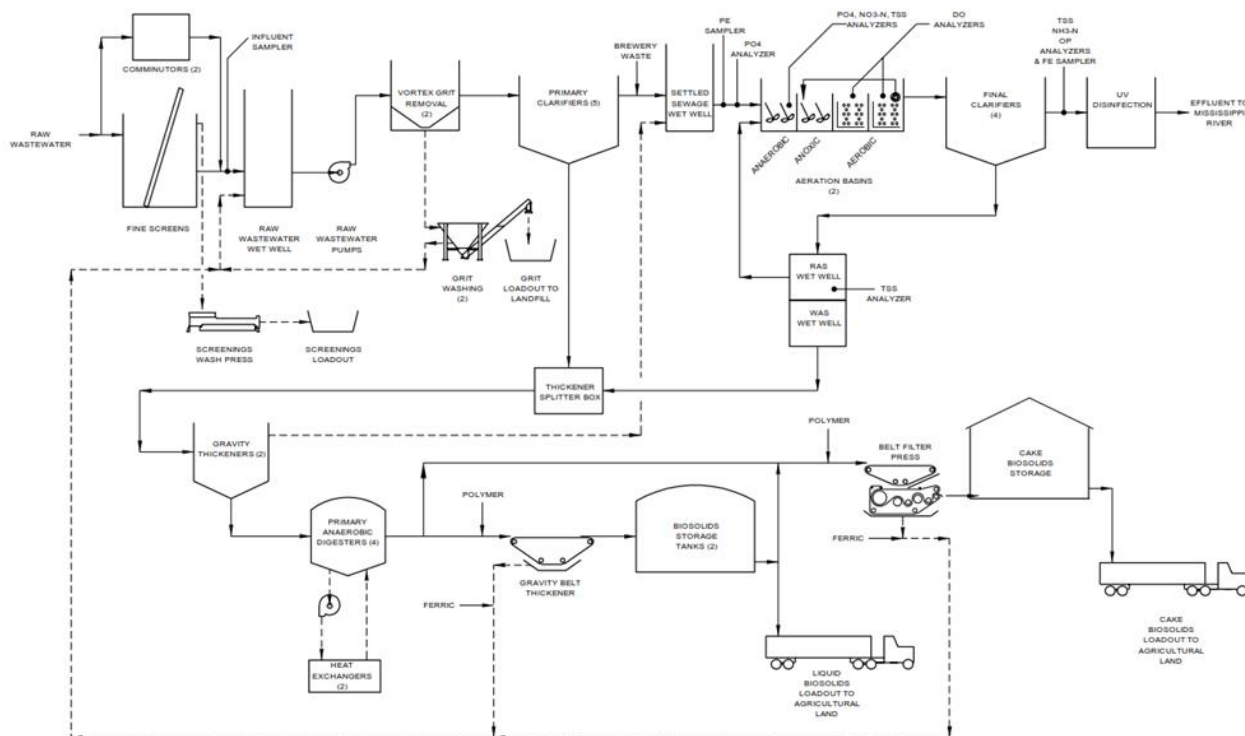


Figure 1 - Isle La Plume WWTP Flow Schematic

The City uses several chemical feed options to supplement Bio-P in achieving effluent phosphorus compliance, including ferric chloride addition to digested sludge thickening/dewatering sidestreams as well as high strength waste addition (typically wastewater from the City Brewery trucked to the plant) to boost Bio-P performance.

2.2 PHOSPHORUS DISCHARGE LIMITS

The WWTP is permitted to discharge treated effluent to the Mississippi River under the rules of the Wisconsin Pollutant Discharge Elimination System (WPDES), specifically operating under the conditions contained in its WPDES Permit No. WI-0029581-09-0. The current permit contains both interim and final (future) limits for effluent total phosphorus (TP) as follows:

- Interim Limit: 1.0 mg/L monthly average.
- Final Water Quality Based Effluent Limit (WQBEL): 0.100 mg/L 6 month average; 0.300 mg/L monthly average.

The final limits become effective January 1, 2025 unless an alternative compliance plan, such as Adaptive Management, is implemented by the City and approved by the Wisconsin Department of Natural Resources (WDNR).

2.3 CURRENT FACILITY LOADINGS & PERFORMANCE

Table 2-1 summarizes current loadings and effluent quality for the WWTP, based on plant operating data for 2013-2015.

Table 2-1 WWTP Loadings & Performance

Location	Flow	BOD5	TSS	TP
Influent Wastewater	10.1 MGD	308 mg/L 25,900 ppd	352 mg/L 29,600 ppd	6.6 mg/L 550 ppd
Final Effluent	9.6 MGD	4.5 mg/L 360 ppd	6.4 mg/L 512 ppd	0.38 mg/L 30.4 ppd

As can be seen in Table 2-1, over the course of the period of record, effluent phosphorus has averaged less than half of the interim effluent limit, but individual monthly averages have at times been significantly higher.

2.4 SPECIAL PHOSPHORUS CHARACTERIZATION SAMPLING

To aid in identifying and evaluating phosphorus removal strategies that may be required for compliance with the future effluent phosphorus limits, the City implemented a limited duration special sampling program during October 2015 to characterize the phosphorus content of its effluent. The results of this special sampling program are summarized in Table 2-2.

Table 2-2 Phosphorus Characterization Special Sampling Summary

Location	TP (mg/L)	RP (mg/L)	AHP (mg/L)	OP (mg/L)
Total Effluent (Unfiltered)	0.235 (0.161-0.311)	0.058 (0.023-0.117)	0.115 (0.008-0.163)	0.061 (0.027-0.088)
Effluent Soluble Fraction (Filtered)	0.096 (0.035-0.190)	0.047 (0.018-0.128)	0.026 (ND-0.060)	0.024 (ND-0.062)
Effluent Particulate Fraction	0.139 (0.031-0.190)	0.011 (ND-0.036)	0.090 (ND-0.125)	0.038 (ND-0.082)

Notes: TP = Total Phosphorus (Digested Sample)

RP = Reactive Phosphorus – Orthophosphorus (PO₄-P)

AHP = Acid Hydrolysable Phosphorus

OP = Organic Phosphorus

Values shown in bold are averages, values in parentheses indicate range of values.

ND = Not detected

Particulate Fraction values are calculated as difference between Total and Soluble values for each day/sample.

With regard to these results, the most notable observations are:

- Effluent phosphorus was over half particulate, which should be amenable to filtration with proper coagulation/flocculation followed by properly sized and functioning effluent filters.
- About half of the soluble portion of effluent phosphorus was reactive orthophosphorus, which is the form available for chemical precipitation. The other half would be expected to be tiny particulate matter small enough to pass a 0.45 micron filter, and hence defined as soluble. This portion will be more challenging to remove through filtration – but with proper coagulation and flocculation, including high energy coagulation mixing energy, the bulk of it should be amenable to removal by effluent filtration as well.
- Additional sampling is recommended to confirm the system's sensitivity towards high concentrations of difficult to remove fractions of phosphorus.

CHAPTER 3 - PHOSPHORUS COMPLIANCE ALTERNATIVE SCREENING

This chapter documents alternative approaches considered feasible in achieving compliance with the future effluent phosphorus limits. The chapter begins with brief descriptions of the potential alternatives, then presents results of a preliminary screening of alternatives to eliminate any deemed impractical or unlikely able to meet the City's needs. The chapter concludes by listing those alternatives retained for further consideration in further detail, from a conceptual implementation standpoint.

3.1 POTENTIAL COMPLIANCE ALTERNATIVE CATEGORIES/APPROACHES

The potential alternative approaches toward compliance include the following general categories:

1. Advanced Treatment at the WWTP to achieve compliance with the 0.100/0.300 mg/L TP limits.
2. Implementing an "Adaptive Management" program in the surrounding watershed.
3. Implementation of "Water Quality Trading".
4. Obtaining a "Variance" derived alternative effluent limit.

Each of these is described further below.

1. Advanced Treatment

The 2015 special sampling suggests that the majority of the effluent phosphorus will be amenable to effluent filtration with proper chemical pretreatment (coagulation/flocculation). As such baseline alternatives include effluent chemical conditioning (ferric/polymer) in rapid mix/flocculation tanks followed by effluent filtration in the form of either sand filters, cloth media disk filters or semi-permeable membrane filters.

Removal to meet the new limits will likely involve other modifications to the treatment facility to make it more efficient at removing phosphorus throughout, including such things as:

- Ferric chloride feed to raw wastewater and possibly to aeration basin effluent, to step-wise decrease phosphorus concentrations through the liquid treatment train via multi-point chemical addition.
- Reconfiguration of the A2O Bio-P activated sludge configuration to a more efficient EBPR configuration for nitrifying activated sludge systems, such as the Modified University of Cape Town (MUCT) configuration.
- Consideration of other improvements to help minimize effluent TSS and TP, such as improving the plant's secondary clarifiers to enhance flocculation of clarifier influent, improve hydraulic characteristics through the clarifiers, or improve settled solids (RAS) removal.

2. Adaptive Management

Adaptive management is a watershed improvement concept where the City would implement and monitor the effect of non-treatment measures in the Mississippi River regional watershed aimed at bringing water quality in the river into compliance with water quality phosphorus standards. It would require the City to authorize funding and activities for implementation of best management practices (BMPs) in an attempt to control non-point sources of phosphorus to the river. In addition to these BMPs, the City would need to provide significant person-hours required to implement the program throughout a multi-year, multi-permit cycle plan.

There is a risk associated with adaptive management in that if the water quality of the river does not show progress to meeting the phosphorus water quality criteria, the facility would be required to continue implementing more BMPs or in the end implement needed upgrades to attain compliance with the 0.100 mg/L WQBEL at the treatment facility. However, if the program were successful, the recalculated water quality based effluent limit would be significantly less stringent (i.e., 0.5 mg/L TP) compared to the 0.100 mg/L WQBEL. Despite this less restrictive limit, it is possible that compliance with a recalculated limit would still require filtration.

The cost for implementing an adaptive management plan can be highly variable, due to varying levels of BMP types and the associated engineering and watershed management efforts required.

3. Trading

Nutrient trading is not common but can be a potential option as a piece of an overall compliance strategy. In such a scenario, typically an upstream stakeholder removes phosphorus more than its permit requires and a downstream stakeholder can “trade” for the excess phosphorus removed. In effect the downstream stakeholder pays the upstream entity to receive credit for some of those pounds of phosphorus removed, to avoid or minimize changes related to enhancing phosphorus removal at its own treatment plant. The result is the downstream stakeholder potentially receives a slightly relaxed phosphorus limit due to the extra treatment provided upstream.

Nutrient trading can involve trading with non-point or point sources of phosphorus discharge. Examples of the former would be trading with agricultural land or municipal separate storm sewer systems (MS4s) to reduce non-point loadings to the watershed upstream of the plant discharge. Examples of point to point source trades would be trading with another WWTP upstream of the City that is removing more phosphorus than it is required to. In either case trade ratios buffer the uncertainty in if a specified trade will provide the needed relief, thus a ratio requires additional mass removal. For example, a minimum of 1.1 pound must be removed for every pound of phosphorus credit in the trade. Costs for trading are often evaluated on a \$/lb of phosphorus traded to compare their net value provided.

Trades with non-point source BMPs in the La Crosse region of the Mississippi River valley will result in a higher proportion of individual trades due to the landscape. Although the terrain is steep and prone to erosion, the smaller parcel size makes obtaining sufficient trade credits for the WWTP offset a very large endeavor.

4. Variance

There are two types of variance that are potentially attainable for some communities.

The first (4.a) is an economic hardship variance, which would require that the cost to modify the plant, to achieve compliance with the WQBEL, when applied on a per user basis, results in user fees exceeding 2% of the mean household income (MHI) of the community.

The second variance option (4.b) is the Statewide Phosphorus Variance, sometimes referred to as the Multi-Discharger Variance (MDV) or the Act 378 Clean Waters Healthy Economy Act. Essentially, this alternative would require the WWTP to comply with 0.8, 0.6 and 0.5 mg/L TP effluent limits over the next three permit cycles, respectively, and pay a fee to participating counties in the watershed to implement non-point BMPs to reduce phosphorus applied to the watershed. At the end of the third permit cycle the City would potentially be required to meet the WQBEL limit of 0.100 mg/L. However,

if the Mississippi River has shown significant improvement in water quality by this time, it is possible the City could receive an alternative, less stringent future limit.

For WWTPs in La Crosse County eligibility for the MDV requires additional stressors – in effect compliance through treatment resulting in user rates exceeding 2% of the community MHI – the same criteria for the hardship variance.

In either case (hardship or MDV) the 2% user rate criteria is not anticipated, or desired. The city's current wastewater collection/treatment user rates are the lowest in the State of Wisconsin.

3.2 IDENTIFICATION/SCREENING OF POTENTIAL COMPLIANCE ALTERNATIVES

Twenty-two potential compliance alternatives were identified and considered as approaches, either stand-alone or in combination, to meet the City's needs. These alternatives were reviewed, discussed and screened to eliminate those considered not practical, with retained alternatives carried forward for further consideration by the City.

Table 3-1 on the next page summarizes the results of the alternative identification/screening activities.

3.3 RETAINED COMPLIANCE ALTERNATIVES

As noted in Table 3-1 the following phosphorus compliance alternatives were carried forward for further evaluation:

- Alternative 1: Optimize Activated Sludge System including Plant SCADA Control System.
- Alternative 3: Optimize Biological Nutrient Removal System: MUCT Process.
- Alternative 5: Install Multi-Point Chemical Feed Facilities. Upon further discussion this alternative was combined to be included as part of Alternatives 7/7A since those alternatives required additional chemical feed facilities as well.
- Alternative 7: Install Effluent Filtration for Full Peak Flow – Membrane or Cloth Media Disk Filters.
- Alternative 7A: Install Effluent Filtration for Max Month Flow – Membrane or Disk Filters.
- Alternative 8: Install Separate WAS Thickening/Continue Gravity Thickening Primary Sludge.
- Alternative 9: Install Sidestream Struvite Harvesting System.
- Alternative 11: Add Storage Tank at WWTP to Feed HSW to BNR System or Digesters.
- Alternative 16: Investigate MS4 Trading with La Crosse and/or Onalaska.

Table 3-1 Phosphorus Compliance Alternatives Identification/Screening Results

Alternative	Retained or Eliminated	Discussion
1. Optimize Activated Sludge System: Final Clarifier, Aeration System & Scum Control Modifications	Retained	Includes upgrades to existing activated sludge facilities including final clarifier modifications (flocculating inlets, effluent weir baffling, and improved rapid sludge withdrawal mechanisms) as well as air supply/control system & other SCADA improvements.
2. Optimize Biological Nutrient Removal System: Johannesburg Process	Eliminated	Eliminate in favor of MUCT (Alt 3) - better use of tankage for higher rate system. Both configurations can outperform existing A2O system for Bio-P in nitrifying activated sludge, but MUCT process outperforms Johannesburg when tankage/space is limiting.
3. Optimize Biological Nutrient Removal System: Modified University Cape Town (MUCT) Process	Retained	Most advantageous/efficient Bio-P nitrifying activated sludge configuration for La Crosse WWTP's situation.
4. Replace Final Clarifiers With Membranes – MBR System	Eliminated	Eliminate - only consider membranes as a secondary effluent filtration alternative.
5. Install Multi-Point Chemical Feed Facilities	Retained	Retained, combine into other alternatives, as it is a preferred concept for all effluent compliance options.
6. Install Effluent Sand Filtration Facilities - Full Peak Flow	Eliminated	Eliminate sand filtration in favor of disk filters due to footprint requirements. Pilot testing has shown smaller footprint disk filters capable of achieving low-level effluent TP.
6.A. Install Effluent Sand Filtration Facilities - Max Month Flow	Eliminated	Eliminate sand filtration in favor of disk filters due to footprint requirements.
7. Install Effluent Filtration Facilities - Full Peak Flow	Retained	Evaluate disk filters and membranes, will likely require effluent pumping.
7.A. Install Effluent Filtration Facilities - Max Week Flow (Right Size)	Retained	Evaluate disk filters and membranes, will likely require effluent pumping.
8. Install Separate WAS Thickening Process/Only Primary Sludge to Gravity Thickeners	Retained	Retained, gravity thickening primary sludge may be supplemental VFA source. Separate thickening may help to minimize sidestream phosphorus loadings.
9. Install Sidestream Struvite Harvesting System	Retained	Retained for placeholder cost purposes for future implementation.

Alternative	Retained or Eliminated	Discussion
10. Upgrade SCADA Control System for Enhanced Process Monitoring & Control	(Retained)	Eliminate as stand-alone alternative, include as part of BNR activated sludge optimization (Alt 1). City has already initiated key SCADA enhancements.
11. Install Dedicated Pipeline from Brewery to High Strength Waste Holding Tank With Ability to Feed Digesters or BNR Anaerobic Zones	(Retained)	Modified as: no pipeline but add storage tank to allow increased hauling along with feed control system using online ortho-P analysis. Pipeline option may be added when trucking is discontinued.
12. Replace Activated Sludge System with Anaerobic Treatment System Plus Nutrient Harvesting	Eliminated	Eliminate, emerging technology not yet proven.
13. Adaptive Management	Eliminated	Eliminate based on the high manpower effort involved to collect and analyze background data, implement BMPs, and monitor results coupled with the likely outcome that efforts will show no appreciable change in the Mississippi River water quality. End result would be a lot of cost and effort expended by the City with no actual benefit apart from potentially delaying construction of new effluent polishing facilities for one or several permit cycles.
14. Effluent Trading: Purchase Phosphorus Credits	(Eliminated)	Eliminated as impractical – unlikely the City could find trading partners to sell enough phosphorus credits (likely in range of 10,000-20,000 lbs P/year) to avoid adding effluent filtration, coupled with the risk if new sources come into system and that trading quantity ended up insufficient, leading to the need to add effluent filtration anyways. Trading may be re-evaluated if effluent filtration becomes insufficient for compliance.
15. Effluent Trading: Exceed Limits and Sell Credits	Eliminated	Eliminate, difficult to exceed limits sufficiently to have credits to sell, and would need to find downstream plant or MS4 to sell to. Best fit would be if City's WWTP exceeds limits and a downstream facility's rates were shown to exceed 2% MHI.
16. Effluent Trading: Trade with LaCrosse/Onalaska MS4 (TP Reductions Exceeding 20% TSS Reduction)	Retained	Retain and evaluate further, along with potential trading with CAFOs in area.
17. Permit Variance: Hardship Variance	Eliminated	Eliminate – City's user rates are lowest in State, considered very unlikely they would rise to exceed 2% of MHI in community.

Alternative	Retained or Eliminated	Discussion
18. Permit Variance: Multi-Discharge Variance	Eliminated	Eliminate - same criteria needed as for hardship variance, plus interim threshold TP limits and payments therefore considered not feasible for same reason.
19. Permit Variance: Site Specific Criteria	Eliminated	Eliminate - requires that receiving waters not impaired, however the Mississippi River already listed as impaired for TSS and phosphorus. A TMDL is likely, however the timing and extend of watershed coverage is unknown.
20. Permit Variance: Contest the Permit	Eliminated	Eliminate for same reasons as variance based on site specific criteria – potentially very costly with unlikely positive outcome at.

CHAPTER 4 - DEVELOPMENT/EVALUATION OF PHOSPHORUS COMPLIANCE ALTERNATIVES

4.1 BASIS OF ALTERNATIVE EVALUATIONS

Table 4-1 documents projected flows which were used to develop sizing and pricing information for treatment alternatives for which projected flows were needed. These flow projections were developed from ongoing 2018 facilities planning projections.

Table 4-1 WWTP Projected Future Influent Flows

Location	Average Day	Maximum Month	Maximum Week	Maximum Day	Peak Hour
Influent Wastewater	13 mgd	13.3 mgd	14.9 mgd	21.2 mgd	42.5 mgd

Ten States Standards sizing for tertiary filtration indicates filters shall be sized for peak hourly flow with one unit out of service. This concept requires a full treatment design flow of 42.5 MGD for new effluent filtration facilities. However, a right-sizing approach, as shown in Figure 4-1, resulted in a firm filter capacity of 16 mgd – which would only intentionally divert flows around filtration for peak/maximum day conditions. This figure shows the future 6-month limit of 0.1 mg/L TP (red dashed line), the future monthly average limit of 0.3 mg/L TP (blue dashed line), and the resulting effluent daily (black dots), monthly average (blue solid line) and 6-month average (red solid line) effluent phosphorus projected to occur assuming that plant flows up to 16 MGD receive full chemical treatment and filtration resulting in an effluent concentration of 0.08 mg/L TP, with any effluent flow exceeding this having an effluent phosphorus concentration of 1.0 mg/L TP (the current interim effluent limit). As can be seen in the figure, effluent filtration to 16 MGD will provide reliable compliance with both the monthly and 6-month limits while avoiding excessive costs for sizing the filters to handle shorter term high flow conditions. The flows used to develop the figure were based on historical plant flow data from 1/1/13 through 12/31/17 escalated by a factor of 1.3 to approximate a similar flow record at future conditions in approximately 20 years.

In terms of economic analysis, a simple Total Present Worth (TPW) analysis was used for comparing alternative costs. This analysis included estimated Initial Costs (design and construction) and only the estimated difference in annual operating costs between alternatives. The annual operating cost values were converted to an equivalent present worth assuming an interest rate of 3%, with the present worth of the annual costs added to the Initial Costs to estimate the TPW of each alternative.

Appendix A presents the TPW analyses for the alternatives discussed below.

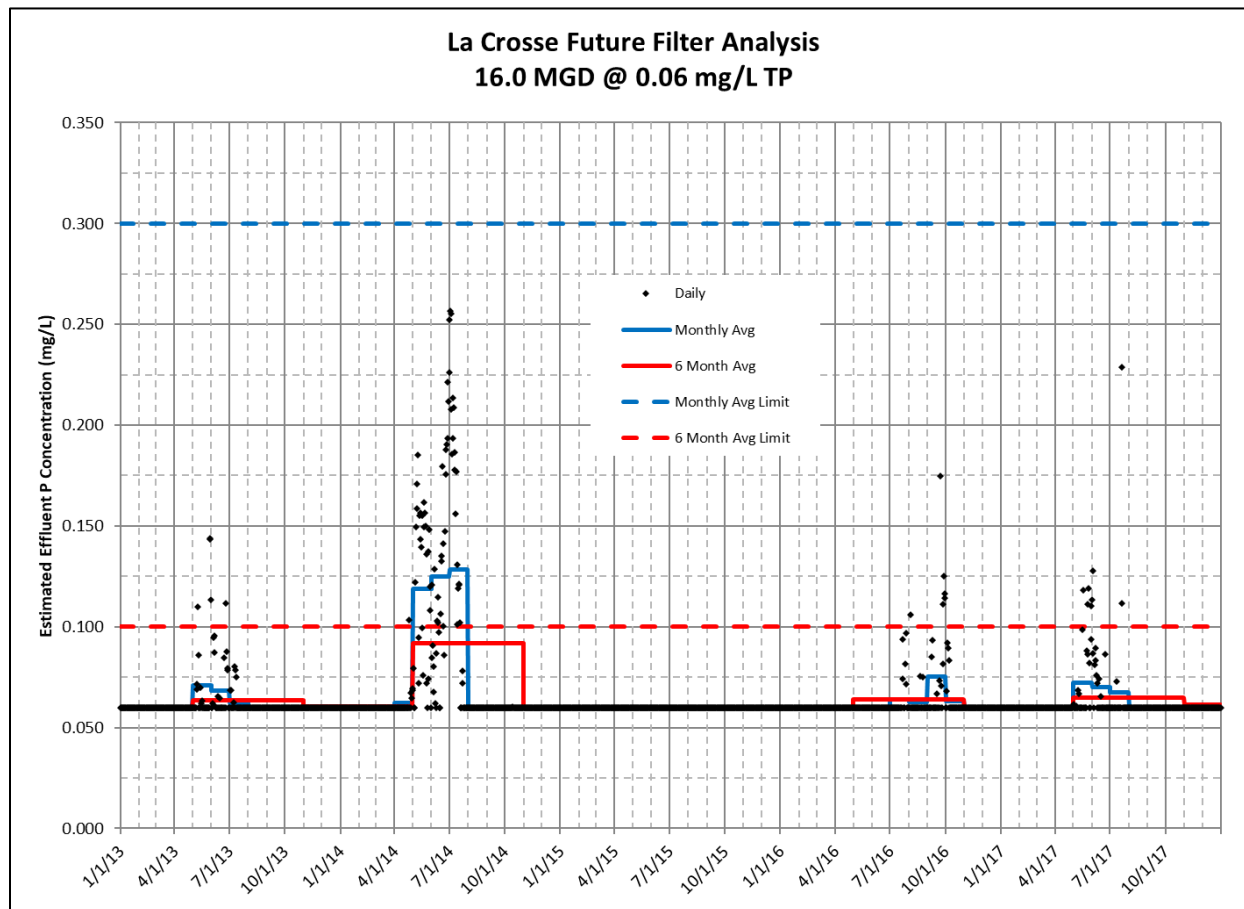


Figure 4-1 Effluent Filter Sizing Estimated Performance

4.2 ALTERNATIVE 1: OPTIMIZE ACTIVATED SLUDGE & UPGRADE SCADA

Alternative 1 includes the following new/revised facilities:

- Primary effluent flow splitting upgrade to better control feed to parallel bioreactors.
- Bioreactor modifications to improve compartmentalization/plug flow through added baffling and by modifying existing baffle walls to allow surface overflow to downstream zones.
- Reconfiguration of aerated versus non-aerated bioreactor zones to enhance biological nutrient removal and overall system performance.
- New final clarifier influent (aeration/mixed liquor effluent) flow splitter box.
- Final clarifier improvements including new flocculating inlets, density current baffles and rapid sludge withdrawal mechanisms.
- RAS piping improvements with dedicated flow isolation valves.

Figure 4-2 is a conceptual plan view showing

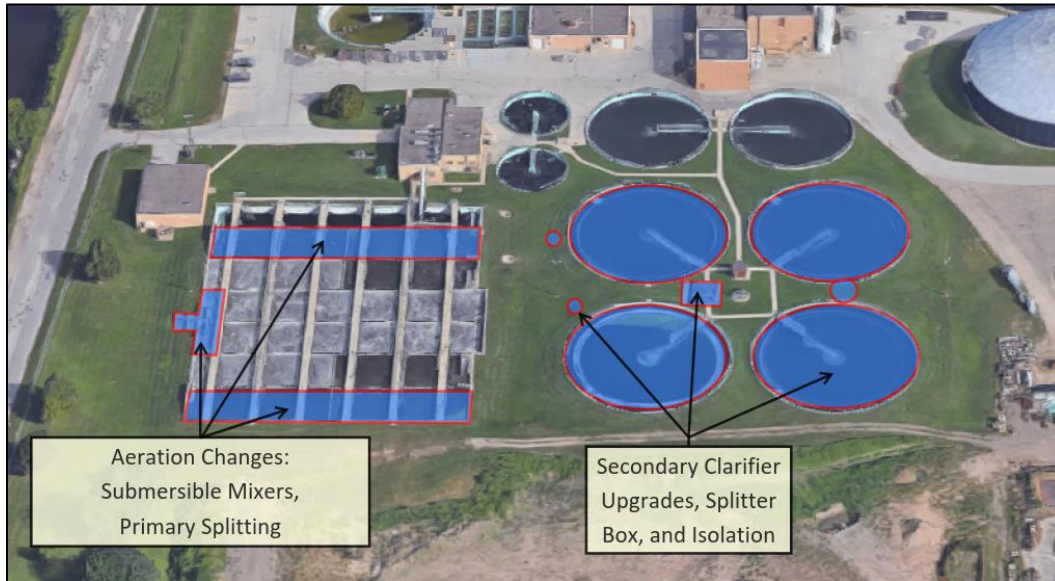


Figure 4-2 Alternative 1 Site Layout

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$3.78 million.
- Estimated incremental annual O&M cost of \$-23,000.
- Estimated TPW of \$3.46 million.

4.3 ALTERNATIVE 3: OPTIMIZE BNR ACTIVATED SLUDGE BY CONVERTING A2O SYSTEM TO MUCT SYSTEM

Alternative 3 is depicted in Figure 4-3 and involves converting from the A2O Bio-P configuration to the Modified University of Cape Town (MUCT) configuration. The alternative includes the following new/revised facilities:

- In concert with Alternative 1, resizing the aerated versus unaerated bioreactor volumes to optimize BNR performance.
- Upgraded aeration system controls (flow control valves, flowmeters, D.O. probes for each half aeration basin) and control system programming.
- Relocating the return activated sludge (RAS) piping from the first unaerated bioreactor zone (anaerobic zone) to instead discharge into the downstream anoxic bioreactor zone.
- Installing new or relocating the existing mixed liquor recycle pumps to pull from the end of each downstream anoxic zone and recycle this denitrified mixed liquor to the influent of each upstream anaerobic zone where the PE is added. This gives the Bio-P organisms the best opportunity to take up the VFAs in the PE and maximize Bio-P performance.



Figure 4-3 Conceptual Plan for MUCT Retrofit

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$1.1 million.
- Estimated incremental annual O&M cost of \$-23,000.
- Estimated TPW of \$0.765 million.

4.4 ALTERNATIVE 7/7A: INSTALL EFFLUENT FILTRATION PLUS ENHANCED CHEMICAL FEED FACILITIES

Alternative 7/7A involves adding effluent polishing coupled with enhanced chemical feed facilities in the form of added phosphorus analyzer monitoring, added chemical feed locations (multi-point chemical feed) and effluent filters in the form of either membrane filters or cloth media disk filters. Common parts of either option include the multi-point chemical feed and additional online phosphorus analyzer(s) capable of low-level orthophosphate monitoring.

With regard to the filtration portion of this alternative there are four possible options:

- Membrane filters sized to handle full peak flows (42.5 mgd)
- Membrane filters sized to handle approximately design max week flows, with higher peak flows bypassing filtration and blending with the filtered effluent.
- Disk filters sized to handle full peak flows (42.5 mgd)
- Disk filters sized to handle approximately design max week flows, with higher peak flows bypassing filtration and blending with the filtered effluent.

With regard to the design flows, section 4.1 above discussed the concept of “right sizing” effluent filtration and showed that full compliance with both the monthly and 6-month average phosphorus limits is expected using a filtration design capacity approximately equal to the design max month flow with higher flows bypassing filtration and blended in. As a result the analysis of filtration alternatives focused on right-

sizing filtration facilities for a capacity of at least 16 MGD, and filtration capacities to handle the full peak hourly flow was eliminated.

With regard to the filtration alternatives, both membrane filters and disk filters are considered adequate to meet the City's requirements. Preliminary cost estimates (both initial capital and TPW) for equal capacity facilities showed disk filters to be roughly 50% of the cost of membrane filters. As a result disk filters were carried forward as the City's preferred low-level TP compliance filtration alternative.

As a result this alternative involves the following aspects:

- Effluent pumping to provide adequate hydraulic capacity for tertiary filtration
- Additional chemical dosing facilities for coagulant (ferric chloride) and flocculant (anionic polymer)
- New rapid mix tankage to ensure coagulant contacts all available soluble phosphorus to precipitate efficiently in a coagulation tank.
- New flocculation tank to agglomerate precipitated particles can merge with the aide of the polymer. This creates larger particles for more effective filtration performance.
- Additional ortho-P analyzer (and potentially turbidity analyzers) for optimizing chemical feed
- New disc filters and surrounding structure
- Clarifier launder covers to prevent algae from restricting filtration performance.

Figure 4-4 shows a conceptual plan of the filtration facility layout on the plant site – with the new filtration facilities located in the plant's no longer needed chlorine contact tank (the plant now uses UV disinfection). The style of filtration (inside-out, or outside-in) may be decided upon preliminary design as it does not restrict the layout or total present worth significantly.

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$7.5 million.
- Estimated incremental annual O&M cost of \$329,000
- Estimated TPW of \$12.1 million.



Figure 4-4 New Effluent Filtration Conceptual Layout

4.5 ALTERNATIVE 8: INSTALL SEPARATE WAS THICKENING/CONTINUE GRAVITY THICKENING PRIMARY SLUDGE.

Alternative 8 includes the following new/ revised facilities:

- One 2-meter gravity belt thickener (or similar technology) for thickening <1%TS WAS to 5-7%TS.
- Thickened sludge feed pump to push the TWAS to the digester.
- Emulsion polymer makedown and dosing system

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$0.86 million.
- Estimated incremental annual O&M cost of \$25,000
- Estimated TPW of \$1.2 million.

4.6 ALTERNATIVE 9: INSTALL SIDESTREAM STRUVITE HARVESTING SYSTEM

Alternative 9 includes the following new/ revised facilities:

- Filtrate pumps at the GBT and BFP to capture the high phosphorus concentration flowstreams
- Upflow fluidized bed reactor system with pH adjustment and magnesium addition to create a spherical or shard of struvite. Struvite harvested will be dried and sieved to create a marketable fertilizer product.

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$6.5 million.
- Estimated incremental annual O&M cost of \$-206,000
- Estimated TPW of \$3.67 million.

4.7 ALTERNATIVE 11: ADD STORAGE TANK AT WWTP TO FEED HSW TO BNR SYSTEM OR DIGESTERS.

Alternative 11 includes the following new/revised facilities:

- Recoats and covers the gravity thickener that is abandoned as part of Alternative 8, to facilitate the receipt, equilization, mixing, and dosing of high strength wastes to either the anaerobic selector zones (for bio-P enhancements), or the anaerobic digesters (for biogas enhancements).

The conceptual TPW analysis for this alternative is shown in Appendix A and result in the following:

- Estimated Initial Cost of \$0.3 million.
- Estimated incremental annual O&M cost of \$0
- Estimated TPW of \$0.3 million.

4.8 ALTERNATIVE 16: INVESTIGATE MS4 TRADING WITH LA CROSSE AND/OR ONALASKA

Alternative 16 involves exploring the potential for trading for phosphorus credits with the municipal separate storm sewer system utilities in La Crosse and Onalaska. There is potential that these facilities have removed excess phosphorus and are able to generate credits. The annual quantity of these credits is unknown at this time and is pending further review by the City. The City intends to summarize their status with MS4 requirements during 2019 to confirm if these credits are available for the WWTP.

The majority of storm outfalls are within the HUC-12 or are upstream within the City limits thus providing a favorable trade ratio.

As mentioned previously with non-point trading, any available MS4 trade is not anticipated to provide sufficient pounds to offset filtration requirements. However, this common sewer service area trade would provide a useful safety factor to the operation of the tertiary disc filter system.

No conceptual costs were identified for this trade.

4.9 ALTERNATIVE CONSIDERATIONS AND DISCUSSION

Table 4-2 summarizes the TPW analyses for the retained alternatives discussed in the preceding sections.

Table 4-2 Phosphorus Alternative TPW Estimated Costs

Alternative	Initial Cost (\$)	Annual O&M Cost (\$/yr)	TPW of Annual O&M (\$)	Total Present Worth (\$)
Alt 1 Optimize Activated Sludge & Upgrade SCADA	3,783,000	-23,000	-324,000	3,459,000
Alt 3 Optimize BNR Activated Sludge by Converting A2O System to MUCT System	1,089,000	-23,000	-324,000	765,000
Alt 7 Install Effluent Filtration Plus Enhanced Chemical Feed Facilities	7,498,000	329,000	4,624,000	12,122,000
Alt 8 Install Separate WAS Thickening/Continue Gravity Thickening Primary Sludge	858,000	25,000	352,000	1,210,000
Alt 9 Install Sidestream Struvite Harvesting System	6,561,000	-206,000	-2,895,000	3,666,000
Alt 11 Add Storage Tank at WWTP to Feed HSW to BNR System or Digesters	306,000	0	0	306,000
Alt 16 Investigate MS4 Trading with La Crosse and/or Onalaska	N/A	N/A	N/A	N/A

Of these retained alternatives, the recommended plan is to implement Alternative 1, 3, 7, 8, and 11. The total initial cost of these improvements is \$13.3 million.

Alternative 9 is not recommended at this time due to the system's high capital cost and indirect benefits to effluent quality. This type of system may be considered at anytime after the effluent filter system is operational to minimize costs and reduce phosphorus to land application. Alternative 16 is not included as the true cost of this alternative is undefined. If said alternative is deemed feasible, and cost-effective, these costs will be included in the Final Compliance Alternatives Plan (FCAP).

During the course of the next year, the City will further refine the alternatives to develop the FCAP.

APPENDIX A: TOTAL PRESENT WORTH COST EVALUATIONS

The pages that follow present the conceptual TPW evaluations for the retained alternatives.

**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

SUMMARY

INITIAL COST ESTIMATE

ALTERNATIVE NO. AND NAME	Initial Cost (\$)	Annual O&M (\$)	Present Worth of Annual O&M (\$)	Total Present Worth (\$)
Alternative 1				
AS-1 A/S Reactor Splitter Box	353,000	0	0	353,000
AS-2 Large Blade Submersible Selector Mixers	355,000	-23,000	-324,000	31,000
AS-4 Sec Clar Splitter Box	936,000	0	0	936,000
AS-5b Modify RAS Piping to Minimize Deposition	224,000	0	0	224,000
AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal	1,600,000	0	0	1,600,000
AS-7 Sec Clar Density Current Baffles	315,000	0	0	315,000
	3,783,000	-23,000	-324,000	3,459,000
Alternative 2				
AS-3 Modified UCT	1,089,000	-23,000	-324,000	765,000
	1,089,000	-23,000	-324,000	765,000
Alternative 7				
EP-1a Cloth Disk Filter with Coagulation Zones	6,871,000	329,000	4,624,000	11,495,000
EP-2 Clarifier Launder Covers	627,000	0	0	627,000
	7,498,000	329,000	4,624,000	12,122,000
Alternative 8				
ST-1d Separate WAS Sludge GBT and Struvite Control	858,000	25,000	352,000	1,210,000
	858,000	25,000	352,000	1,210,000
Alternative 9				
SC-1 Sidestream Struvite Harvesting System	6,561,000	-206,000	-2,895,000	3,666,000
	6,561,000	-206,000	-2,895,000	3,666,000
Alternative 11				
PC-2 HSW and Septage Receiving at GT 1	306,000	0	0	306,000
	306,000	0	0	306,000

**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

AS-1 A/S Reactor Splitter Box

INITIAL COST ESTIMATE

General Description

This alternative is to modify an existing structure which intercepts primary effluent at the the west end of the aeration basins and construct a splitter box with weirs to split flow and reconnect to existing piping.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			5,193
Concrete	See Worksheet for Detailed Cost Breakdown			40,400
Metals	See Worksheet for Detailed Cost Breakdown			3,220
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Locally Operated Isolation Gates	Each	2	15,000	30,000
Piping (CL-DI, 30")	Lump Sum	1	30,000	30,000
Fittings	Lump Sum	1	30,000	30,000
Bypass Pumping	Lump Sum	1	50,000	50,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				188,813
Contingency			30%	56,644
Subtotal				245,457
Contractor Overhead & Profit			25%	61,364
Total Construction Cost				306,821
Engineering			15%	46,023
Total Initial Cost				353,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-1 A/S Reactor Splitter Box

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	866	866
Earthwork: Excavation	cu yds	81	20	1,618
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft^2	162	16.75	2,710
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				5,193
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	6	400	2,400
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds	32	1,200	38,000
Concrete: Precast Roof	ft			
Concrete				40,400
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft	46	70	3,220
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				3,220
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-1 A/S Reactor Splitter Box

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	70
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

INITIAL COST ESTIMATE

General Description

This alternative shows the costs associated with converting the current submersible mixer assets to large blade submersibles. This will include installing more robust supports, purchase of the mixers, and installation. The number of mixers corresponds to the number needed for a conversion to modified UCT layout, and is not representative of a conversion under the current system.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	0
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Large Blade Submersible Mixer	Each	4	33,833	135,332
Tripod	Each	4	5,769	23,076
Startup	Lump Sum	1	2,500	2,500
Freight	Lump Sum	1	9,000	9,000
Installation	Lump Sum	1	20,000	20,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				189,908
Contingency			30%	56,972
Subtotal				246,880
Contractor Overhead & Profit			25%	61,720
Total Construction Cost				308,601
Engineering			15%	46,290
Total Initial Cost				355,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	New	Existing
Number of Motors Operating	4.00	8.00
Brake Horsepower of Each Operating Motor	5.4	15.0
Total Bhp	22	120
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	100%	100%
Wire Horsepower	23	130
Wire Kilowatts	18	97
Operating Hours Per Day	24	12
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	4,368

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity (Savings)	Kw-hrs	-272,016	0.083	-22,577

Total Annual Cost **-23,000**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **-324,000**

**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

AS-4 Sec Clar Splitter Box

INITIAL COST ESTIMATE

General Description

This alternative is for the addition of a new structure to more equally split ML flow between the final clarifiers.. This includes the new piping routed to the clarifiers, new locally controlled isolation gates, and installation of these new systems.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			24,658
Concrete	See Worksheet for Detailed Cost Breakdown			185,378
Metals	See Worksheet for Detailed Cost Breakdown			22,785
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			8,000
Locally Operated Isolation Gates (10')	Each	4	15,000	60,000
Install	Lump Sum	1	20,000	20,000
ML Piping (CL-DI, 36")	Lump Sum	1	150,000	150,000

Civil Not Listed Above	Lump Sum	1	25,000	25,000
Electrical Not Listed Above	Lump Sum	1	5,000	5,000
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				500,821
Contingency			30%	150,246
Subtotal				651,068
Contractor Overhead & Profit			25%	162,767
Total Construction Cost				813,834
Engineering			15%	122,075
Total Initial Cost				936,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-4 Sec Clar Splitter Box

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	4,110	4,110
Earthwork: Excavation	cu yds	482	20	9,644
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	sq ft	651	16.75	10,904
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				24,658
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	72	400	28,933
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds	130	1,200	156,444
Concrete: Precast Roof	ft			
Concrete				185,378
Metals: Aluminum Grating	sq ft	651	35	22,785
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				22,785
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition existing piping	lump sum	1	8,000	8,000
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				8,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-4 Sec Clar Splitter Box

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	90
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

INITIAL COST ESTIMATE

General Description

This alternative is for the inclusion of isolation valves on the suction RAS lines emerging from each clarifier. These valves will allow for the clearing of blockages in the lines.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
20" Buried RAS Valve	Each	4	20,000	80,000
RAS Chlorination System	Lump Sum	1	35,000	35,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	2,500	2,500
Instrumentation and Control Not Listed Above	Lump Sum	1	1,500	1,500
Plumbing Not Listed Above	Lump Sum	1	500	500
HVAC Not Listed Above	Lump Sum			

Subtotal				119,500
Contingency			30%	35,850
Subtotal				155,350
Contractor Overhead & Profit			25%	38,838
Total Construction Cost				194,188
Engineering			15%	29,128
Total Initial Cost				224,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-5b Modify RAS Piping to Minimize Deposition

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	90
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

INITIAL COST ESTIMATE

General Description

This alternative includes the modifications necessary to install Tow Bro sludge withdrawal mechanisms as well s FEDWA inlets. Together, these technologies help to ensure settling and prevent excessive disturbance of the sludge blanket.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork			See Worksheet for Detailed Cost Breakdown	0
Concrete			See Worksheet for Detailed Cost Breakdown	0
Metals			See Worksheet for Detailed Cost Breakdown	0
Buildings			See Worksheet for Detailed Cost Breakdown	0
Demolition			See Worksheet for Detailed Cost Breakdown	0
Tow Brow/FEDWA	Each	4	209,000	836,000
Equipment	Lump Sum	1	10,000	10,000
Labor	Lump Sum	1	10,000	10,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				856,000
Contingency			30%	256,800
Subtotal				1,112,800
Contractor Overhead & Profit			25%	278,200
Total Construction Cost				1,391,000
Engineering			15%	208,650
Total Initial Cost				1,600,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-6 Sec Clar FEDWA Inlet / Rapid Sludge Withdrawal

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	90
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

INITIAL COST ESTIMATE

General Description

This alternative is for the installation of density current baffles which prevent short circuiting within the clarifiers.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost</u> <u>(\$)</u>	<u>Initial Cost</u> <u>(\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Density Current Baffles	Each	4	36,030	144,120
Install	Each	4	6,000	24,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum			
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				168,120
Contingency			30%	50,436
Subtotal				218,556
Contractor Overhead & Profit			25%	54,639
Total Construction Cost				273,195
Engineering			15%	40,979
Total Initial Cost				315,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-7 Sec Clar Density Current Baffles

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	90
Brake Horsepower of Each Operating Pump	0
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

AS-3 Modified UCT

INITIAL COST ESTIMATE

General Description

This alternative involves modifying the BNR system from the A2O process to the Modified University of Cape Town (MUCT) Variation process. It involves extending the RAS piping to the beginning of the anoxic zones and relocating the existing ML recycle pumps to pump denitrified mixed liquor back to the beginning of the first anaerobic zones.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
9" Membrane Diffuser	Lump Sum	2,700	35	95,500
24" RAS Piping	Ft	460	300	138,000
Relocated Denitrified ML Recycle Pumps	Each	2	8,000	16,000
30" ML Recycle Piping	Each	240	350	84,000
Install	Lump Sum	1	100,000	100,000
Airflow Control Improvements	Lump Sum	1	89,000	89,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	15,000	15,000
Instrumentation and Control Not Listed Above	Lump Sum	1	45,000	45,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			
<hr style="border-top: 1px dashed black;"/>				
Subtotal				582,500
Contingency			30%	174,750
Subtotal				757,250
Contractor Overhead & Profit			25%	189,313
Total Construction Cost				946,563
Engineering			15%	141,984
Total Initial Cost				1,089,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-3 Modified UCT

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-3 Modified UCT

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	New	Existing
Number of Blowers Operating	2.00	2.00
Brake Horsepower of Each Operating Unit	157.5	175.0
Total Bhp	315	350
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	380	423
Wire Kilowatts	284	315
Operating Hours Per Day	24	24
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity (Savings)	Kw-hrs	-275,479	0.083	-22,865

Total Annual Cost **-23,000**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **-324,000**

**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

EP-1a Cloth Disk Filter with Coagulation Zones

INITIAL COST ESTIMATE

General Description

This alternative includes disc filters to bring effluent phosphorus down to future permit levels. This also includes the expected cost of storing the dosing chemicals and maintaining the system. System is located within the area of the chlorine contact tank.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			20,912
Concrete	See Worksheet for Detailed Cost Breakdown			336,601
Metals	See Worksheet for Detailed Cost Breakdown			29,157
Buildings	See Worksheet for Detailed Cost Breakdown			460,349
Demolition	See Worksheet for Detailed Cost Breakdown			0
Disk Filter (firm capacity)	MGD	16	78,125	1,250,000
Disk Filter (redundancy)	MGD	8.0	78,125	625,000
Disk Filter Installation	Lump Sum	1	120,000	120,000
Pre-Filtration Pumping (5 MGD)	Each	4	45,000	180,000
Polymer Makedown and Dose System	Each	2	15,000	30,000
5000 Gallon Alum Storage Tank (1 month)	Each	1	15,000	15,000
Piping/Fittings (30", CL-DI)	Lump Sum	1	153,750	153,750
Valves	Per Filter	3	72,000	216,000
4'x4' Roof Hatch (pump access)	Each	4	2,500	10,000

Civil Not Listed Above	Lump Sum	1	5,000	5,000
Electrical Not Listed Above	Lump Sum	1	100,000	100,000
Instrumentation and Control Not Listed Above	Lump Sum	1	80,000	80,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum	1	40,000	40,000

Subtotal				3,676,768
Contingency			30%	1,103,030
Subtotal				4,779,798
Contractor Overhead & Profit			25%	1,194,950
Total Construction Cost				5,974,748
Engineering			15%	896,212
Total Initial Cost				6,871,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

EP-1a Cloth Disk Filter with Coagulation Zones

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	3,485	3,485
Earthwork: Excavation	cu yds	342	20	6,833
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft	632	16.75	10,594
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				20,912
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds	23	400	9,370
Concrete: Walls	cu yds	244	1,200	292,446
Concrete: Floor Slabs	cu yds		1,000	0
Concrete: Structural Slabs	cu yds		1,000	0
Concrete: Columns	cu yds		1,600	0
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft	3,478	10	34,785
Concrete				336,601
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft	196	70	13,728
Metals: Aluminum Stairway	risers	31	500	15,429
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				29,157
Building: Over Disk Filters	sq ft	3,478	100	347,849
Building: Over Floc/Coag/Mix and Chem Struct	sq ft	750	150	112,500
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				460,349
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

EP-1a Cloth Disk Filter with Coagulation Zones

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Rapid Mix	Coag Mix	Floc Mix	Submersible pumps
Number of Pumps Operating	1	1	1	3
Brake Horsepower of Each Operating Pump	5.0	7.5	1.0	45.0
Total Bhp	5	8	1	135
Motor Efficiency	92%	92%	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%	90%	90%
Wire Horsepower	6	9	1	163
Wire Kilowatts	5	7	1	122
Operating Hours Per Day	24	24	24	24
Operating Days Per Week	7	7	7	7
Operating Weeks Per Year	52	52	52	52
Operating Hours Per Year	8,736	8,736	8,736	8,736

<u>General Description</u>	Backwash Pumps	Filter Rotate
Number of Pumps Operating	2	2
Brake Horsepower of Each Operating Pump	25.0	1.5
Total Bhp	50	3
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	90%
Wire Horsepower	60	4
Wire Kilowatts	45	3
Operating Hours Per Day	4	4
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	1,456	1,456

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	1,238,346	0.083	102,783
Ferric Chloride	Gal	169,875	1.17	198,753
Polymer	lb	21,931	1.21	26,536
Total Annual Cost				329,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	4,624,000
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**City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI**

EP-2 Clarifier Launder Covers

INITIAL COST ESTIMATE

General Description

This alternative includes launder covers for the secondary clarifiers to prevent algal growth.

<u>ITEM</u>	<u>Units</u>	<u>Quantity</u>	<u>Unit Cost (\$)</u>	<u>Initial Cost (\$)</u>
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Launder Covers	Each	4	67,000	268,000
Labor	Each	4	16,750	67,000
<hr style="border-top: 1px dashed black;"/>				
Civil Not Listed Above	Lump Sum	0	0	
Electrical Not Listed Above	Lump Sum	0	0	
Instrumentation and Control Not Listed Above	Lump Sum	0	0	
Plumbing Not Listed Above	Lump Sum	0	0	
HVAC Not Listed Above	Lump Sum	0	0	
<hr style="border-top: 1px dashed black;"/>				
Subtotal				335,000
Contingency			30%	100,500
Subtotal				435,500
Contractor Overhead & Profit			25%	108,875
Total Construction Cost				544,375
Engineering			15%	81,656
Total Initial Cost				627,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

EP-2 Clarifier Launder Covers

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

EP-2 Clarifier Launder Covers

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	90
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	0
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

INITIAL COST ESTIMATE

General Description

This alternative is to thicken the WAS to 5% TS prior to digestion on a GBT. Primary sludge would thicken separately in the south gravity thickener to 5% TS.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			2,000
Metals	See Worksheet for Detailed Cost Breakdown			20,000
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Gravity Belt Thickener (2-Meter)	Each	1	250,000	250,000
Thin Sludge Feed Pump/Meter	Each	0	20,000	0
Polymer Unit	Each	1	21,000	21,000
Thickened Sludge Pump	Each	1	16,000	16,000
Piping, Fittings, and Valves	Lump Sum	1	65,000	65,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum	1	40,000	40,000
Instrumentation and Control Not Listed Above	Lump Sum	1	40,000	40,000
Plumbing Not Listed Above	Lump Sum	1	5,000	5,000
HVAC Not Listed Above	Lump Sum			

Subtotal				459,000
Contingency			30%	137,700
Subtotal				596,700
Contractor Overhead & Profit			25%	149,175
Total Construction Cost				745,875
Engineering			15%	111,881
Total Initial Cost				858,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab (Equipment Pads)	Lump Sum	1	2,000	2,000
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				2,000
Metals: Aluminum Grating and Platforms	Lump Sum	1	20,000	20,000
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				20,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

ST-1d Separate WAS Sludge GBT and Struvite Control

ANNUAL O&M COST ESTIMATE

<u>General Description</u>	Drive	W3
Number of Pumps Operating	1	1
Brake Horsepower of Each Operating Pump	2	1.2
Total Bhp	2	1
Motor Efficiency	92%	92%
Adjustable Frequency Drive Efficiency	90%	100%
Wire Horsepower	2	1
Wire Kilowatts	2	1
Operating Hours Per Day	24	24
Operating Days Per Week	7	7
Operating Weeks Per Year	52	52
Operating Hours Per Year	8,736	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	24,242	0.083	2,012
Polymer	lb	11,498	1.21	13,912
Ferric Chloride	Gal	7,300	1.17	8,541

Total Annual Cost **25,000**

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost **352,000**

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

SC-1 Sidestream Struvite Harvesting System

INITIAL COST ESTIMATE

General Description

This option is for installation of a filtrate precipitation system to harvest phosphorus in the form of struvite (Magnesium, Ammonia, and Phosphorus). Controlled formation of shards or pearls of struvite is obtained in an upflow bed reactor at a pH of 7.8 with excess magnesium added. The reactor precipitation will reduce the dependence on ferric chloride.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			9,500
Concrete	See Worksheet for Detailed Cost Breakdown			26,400
Metals	See Worksheet for Detailed Cost Breakdown			0
Buildings	See Worksheet for Detailed Cost Breakdown			5,000
Demolition	See Worksheet for Detailed Cost Breakdown			0
Ostara System	ea	1	2,805,000	2,805,000
GBT/BFP filtrate submersible pumps	ea	2	16,500	33,000

Civil Not Listed Above	%	1	35,109	35,109
Process Mechanical Not Listed Above	%	2	70,217	140,434
Electrical Not Listed Above	%	2	70,217	140,434
Instrumentation and Control Not Listed Above	%	2	70,217	140,434
Plumbing Not Listed Above	%	1	35,109	35,109
HVAC Not Listed Above	%	2	70,217	140,434

Subtotal				3,510,854
Contingency			30%	1,053,256
Subtotal				4,564,110
Contractor Overhead & Profit			25%	1,141,027
Total Construction Cost				5,705,137
Engineering			15%	855,771
Total Initial Cost				6,561,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

SC-1 Sidestream Struvite Harvesting System

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum	1	1,500	1,500
Earthwork: Excavation	cu yds	200	40	8,000
Earthwork: Excavation	ft			
Earthwork: Excavation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				9,500
Concrete: Base Slab	cu yds	12	400	4,800
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds	13	1,200	15,600
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds	5	1,200	6,000
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				26,400
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals:				
Metals				0
Building:	sq ft	500	10	5,000
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				5,000
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

SC-1 Sidestream Struvite Harvesting System

ANNUAL O&M COST ESTIMATE

General Description **Ostara System**

Number of Motors Operating	1
Brake Horsepower of Each Operating Pump	30
Total Bhp	30
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	36
Wire Kilowatts	27
Operating Hours Per Day	24
Operating Days Per Week	7.0
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

<u>ITEM</u>	<u>Units</u>	<u>Annual Quantity</u>	<u>Unit Cost (\$)</u>	<u>Annual Cost (\$)</u>
Electricity	Kw-hrs	236,125	0.083	19,598
Ferric Chloride Savings	Gal	-150,000	1.17	-175,500
Solids Disposal Savings	Ton	-270	183.00	-49,410
Struvite Harvested	lb	-81,633	0.00	0
Total Annual Cost				-206,000

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053

Present Worth of Total Annual Cost	-2,895,000
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City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

INITIAL COST ESTIMATE

General Description

This alternative is to convert the North gravity thickener (GT) for high strength waste (HSW). This offers potential savings by reusing existing pumps and piping to push wastes to the digesters.

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Architectural/Structural				
Earthwork	See Worksheet for Detailed Cost Breakdown			0
Concrete	See Worksheet for Detailed Cost Breakdown			0
Metals	See Worksheet for Detailed Cost Breakdown			68,722
Buildings	See Worksheet for Detailed Cost Breakdown			0
Demolition	See Worksheet for Detailed Cost Breakdown			0
Truck receiving System (pipe, valve pit, bar rake)	Lump Sum	1	50,000	50,000
High Build Coating	Lump Sum	1	30,000	30,000

Civil Not Listed Above	Lump Sum			
Electrical Not Listed Above	Lump Sum			
Instrumentation and Control Not Listed Above	Lump Sum	1	15,000	15,000
Plumbing Not Listed Above	Lump Sum			
HVAC Not Listed Above	Lump Sum			

Subtotal				163,722
Contingency			30%	49,117
Subtotal				212,839
Contractor Overhead & Profit			25%	53,210
Total Construction Cost				266,049
Engineering			15%	39,907
Total Initial Cost				306,000

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

ARCHITECTURAL/STRUCTURAL WORKSHEET

ITEM	Units	Quantity	Unit Cost (\$)	Initial Cost (\$)
Earthwork: Dewatering	lump sum			
Earthwork: Excavation	cu yds			
Earthwork: Underdrain System	sq yds			
Earthwork: Pile Foundation	ft			
Earthwork: Flood Protection Levee	cu yds			
Earthwork: Flood Protection Gravel Road	sq yds			
Earthwork:				
Earthwork				0
Concrete: Footings	cu yds			
Concrete: Base Slab	cu yds			
Concrete: Walls	cu yds			
Concrete: Floor Slabs	cu yds			
Concrete: Structural Slabs	cu yds			
Concrete: Columns	cu yds			
Concrete: Channels	cu yds			
Concrete: Precast Roof	ft			
Concrete				0
Metals: Aluminum Grating	sq ft			
Metals: Aluminum Handrail	ft			
Metals: Aluminum Stairway	risers			
Metals: Baffles and Weirs	sq ft			
Metals: Aluminum Geodesic Dome	sq ft	1,963	35	68,722
Metals				68,722
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Building:	sq ft			
Buildings				0
Demolition:	cu ft			
Demolition:	cu ft			
Demolition:	lump sum			
Demolition:	lump sum			
Demolition				0

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

PC-2 HSW and Septage Receiving at GT 1

ANNUAL O&M COST ESTIMATE

General Description

Number of Pumps Operating	
Brake Horsepower of Each Operating Pump	60
Total Bhp	0
Motor Efficiency	92%
Adjustable Frequency Drive Efficiency	90%
Wire Horsepower	0
Wire Kilowatts	0
Operating Hours Per Day	24
Operating Days Per Week	7
Operating Weeks Per Year	52
Operating Hours Per Year	8,736

ITEM	Units	Annual Quantity	Unit Cost (\$)	Annual Cost (\$)
Electricity	Kw-hrs	0	0.083	0
Total Annual Cost				0

Present Worth Analysis

Interest Rate Per Year	3.62500%
Number of Years	20
Present Worth Factor	14.053
Present Worth of Total Annual Cost	0



Endangered Resources Preliminary Assessment

Created on **12/27/2018**. This report is good for one year after the created date.

Results

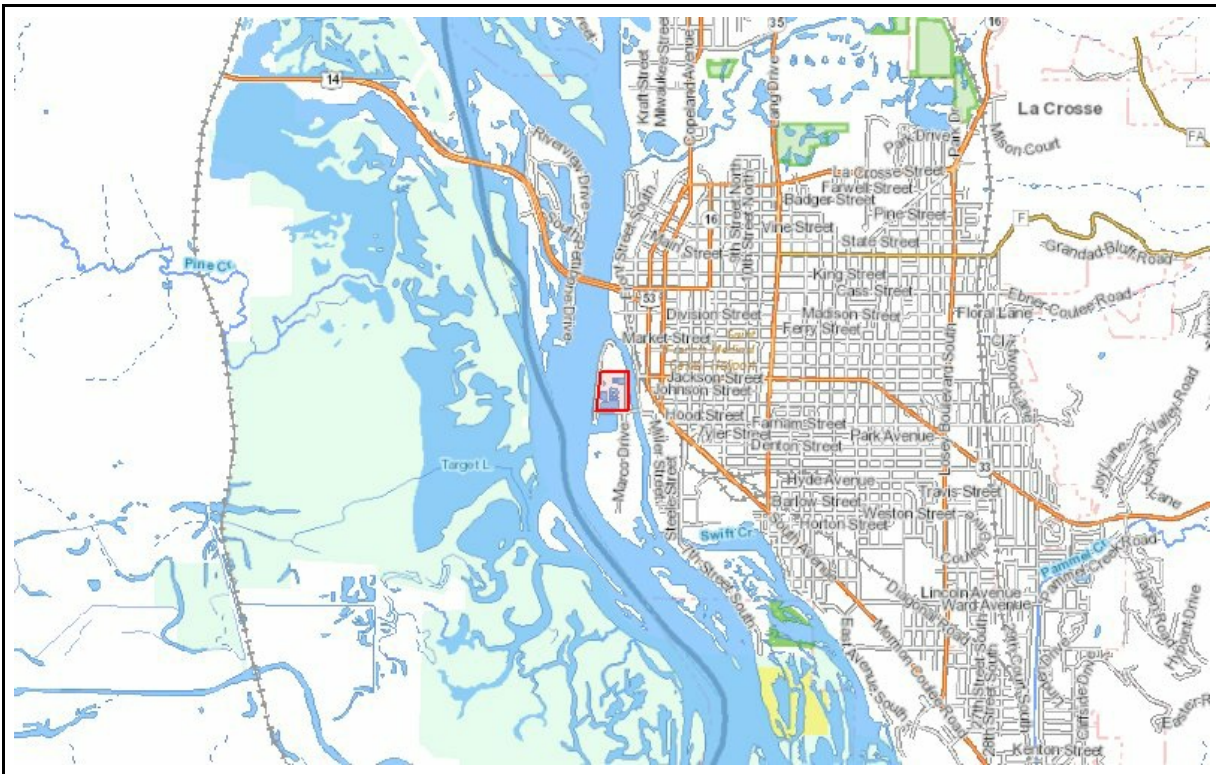
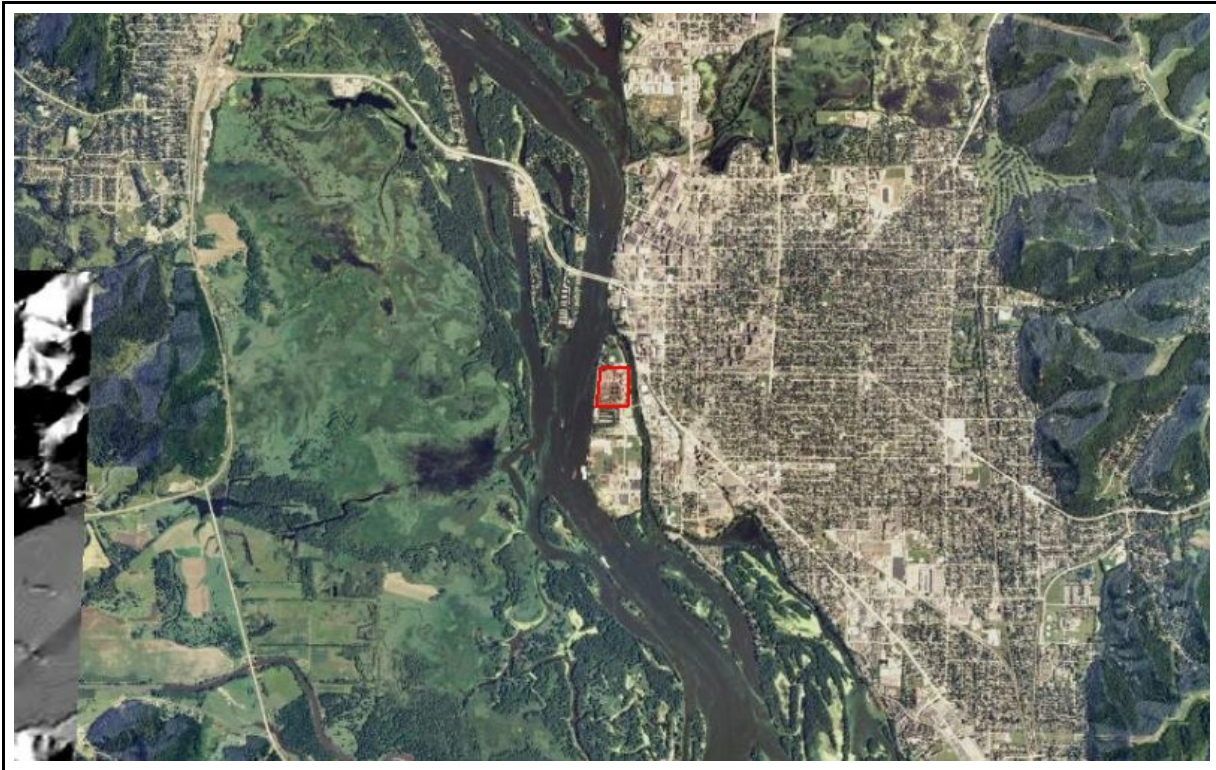
Endangered resources are present and the species present are legally protected. **Further actions are required to ensure compliance** with Wisconsin's Endangered Species Law (s. 29.604 Wis. Stats.) and the Federal Endangered Species Act (16 USC ss 1531-43). Therefore you should request an Endangered Resources Review <http://dnr.wi.gov/topic/ERReview/Review.html>.

Project Information

Landowner name	City of La Crosse
Project address	905 Joseph Houska Drive, La Crosse, WI 54601
Project description	Wastewater Treatment Plant - construction within existing fenceline

Project Questions

Does the project involve a public property?	Yes	Is the project a utility, agricultural, forestry or bulk sampling (associated with mining) project?	Yes
Is there any federal involvement with the project?	No	Is the project property in Managed Forest Law or Managed Forest Tax Law?	No



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<https://dnrx.wisconsin.gov/nhiportal/public>

101 S. Webster Street . PO Box 7921 . Madison, Wisconsin 53707-7921

Technical Memorandum 7
Recommended Plan
Strategic Plan: Wastewater Treatment
La Crosse Wastewater Treatment Facility
La Crosse, Wisconsin



Date: May 28, 2019

To: Bernard Lenz – Utilities Manager

Copy: Jared Greeno, WWTF Superintendent
Brian Hein – WWTF Assistant Superintendent
Greg Kozelek – City Engineer

From: Mike Gerbitz – Donohue & Associates

By: Bill Marten – Donohue & Associates
Eric Lynne – Donohue & Associates
Ben Stephens – Donohue & Associates

Purpose

The purpose of this Technical Memorandum (TM) is to present the Recommended Plan for the implementation of upgrades to the wastewater treatment facility resulting from the wastewater facilities planning process. While TM 6 evaluated the cost effectiveness of alternatives and identified the recommended improvements to meet the City's 20-year wastewater treatment needs, this TM 7 provides a summary of the recommended plan and the implementation packages that were considered for the 20-year treatment needs. Sewer rate impacts were also determined for the various implementation packages.

Technical Plan

During the Alternatives Evaluation Workshop, the project team discussed the priority level for each improvement. The majority of the improvements were identified as a near-term priority, with only the following list as a mid- to long-term priority. Recent maintenance improvements to these unit processes has extended their implementation schedule; thus deferring the respective capital expenditures to minimize rate impacts. It is anticipated these improvements would be implemented in subsequent years of the planning period when equipment maintenance exceeds the replacement cost. Table 1 summarizes the recommended capital improvements plan.

A general layout of the treatment facility indicating the various improvements is provided in Figure 1.

Table 1 – WWTF Capital Improvements Plan

Unit Process	Description	YR 0-5	YR 5-10	YR 10+
Headworks	Fine Screen	\$1.0M		
	Grit System Programming	\$0.01M		
	HVAC Replacement	\$0.3M		
	Septage and Holding Receiving	\$0.5M		\$1.0M
Primary Clarification	Scum Pit 3 Pump w/ HSW Tank	\$0.6M		
	HSW and Septage Receiving at GT 1		\$0.5M	
Activated Sludge	A/S Reactor Splitter Box	\$0.4M		
	Large Blade Submersible Selector Mixers	\$0.4M		
	Modified UCT	\$1.0M		
	Sec Clar Splitter Box	\$0.9M		
	Modify RAS Piping to Minimize Deposition	\$0.2M		
	Sec Clar FEDWA Inlet / Rapid Sludge Removal			\$1.6M
	Sec Clar Density Current Baffles	\$0.3M		
Effluent Phosphorus	Cloth Disk Filter with Coagulation Zones	\$5.6M		
	Clarifier Launder Covers	\$0.6M		
Disinfection	Replacement UV System			\$1.9M
Sludge Thickening	WAS GBT and Struvite Control	\$0.7M		
Digestion	TPAD Conversion	\$3.0M		
	Digester Mixing with Draft Tube & Jet Mixing	\$1.6M		
Biosolids Reuse	Increase Diversity by Drying 70% of Biosolids	\$19.5M		
	Improve Biosolids Quality	\$1.1M		
Biogas	Replace Waste Gas Burner	\$0.4M		
	Cogeneration Engine with Gas Storage	\$5.3M		
Site and Utilities	Replace Facility Wide Heating System	\$0.6M		
	Comply with NFPA 820 & 10-State Standards	\$2.2M		
	Increase W3 System Capacity	\$0.4M		
	New Transformers and One Electrical Service	\$2.5M	\$2.0M	
	Floodplain, Site Access, and Misc	\$0.4M		
Subtotal		\$49.5M	\$2.5M	\$4.5M

Deferment of these projects reduces the total initial cost of near-term recommended improvements to \$50 million. It is recommended that these projects be clustered into one (or a few) larger set(s) for efficiency with design, bidding, construction pricing, and convenience to operations staff. To implement the near-term items, an schedule was developed to prepare for action items and deliverables associated with this major set of projects to be developed.

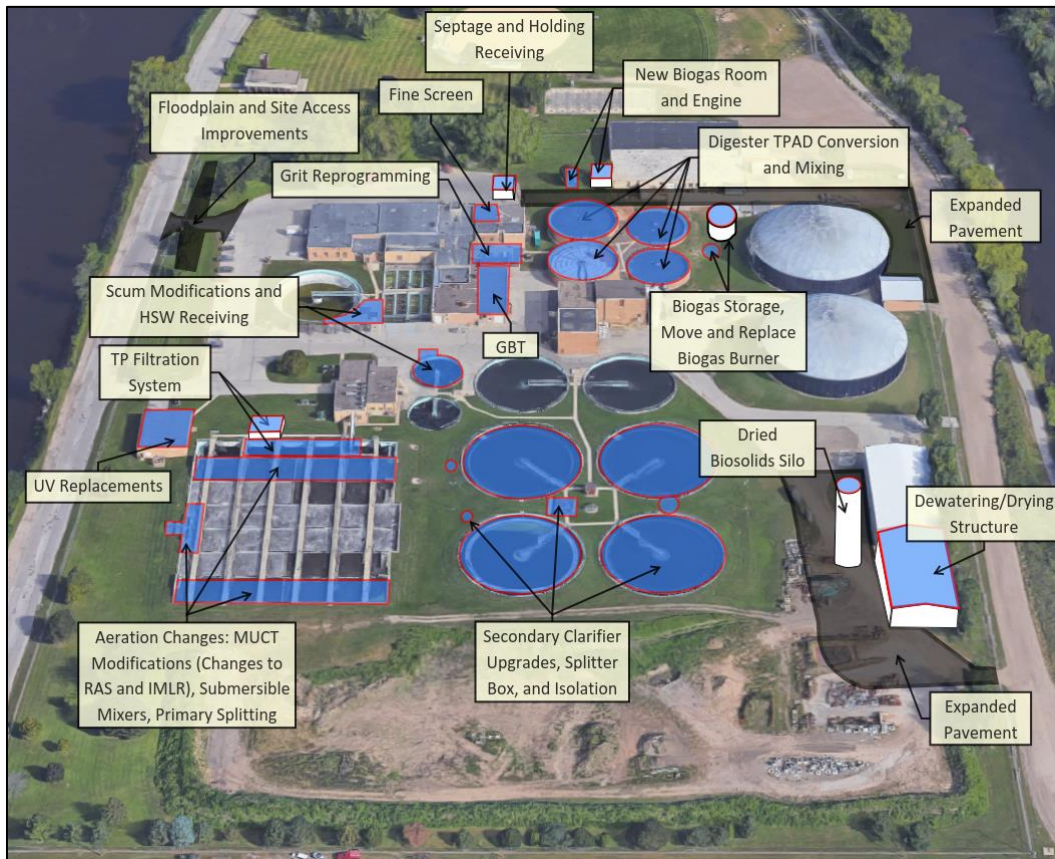


Figure 1 – Treatment Plant 20-Year CIP Improvements

The near-term implementation schedule is provided in Figure 2. The current discharge permit requires initiation of construction in 2022, with ultimate compliance by January 1, 2025. The staff indicated preference to have a minimum of one year prior to this compliance deadline to run the new system allowing the operators to become familiar with the new technology. The schedule in Figure 2 was developed to provide a defensible path towards implementation. The schedule could be condensed by reducing the preliminary design phase; however, this phase is critical to the City to obtain stakeholder input and initialize technologies and equipment preferences. A key benefit to a separate preliminary design, is its ability to control costs, as many of the rate payers cannot tolerate an unexpected increase in project costs.

Additionally, during this preliminary layout phase, it is recommended to conduct demonstration scale validation tests for the main treatment changes (phosphorus and biosolids) confirm performance, sizing, and operating costs prior to entering detailed design.

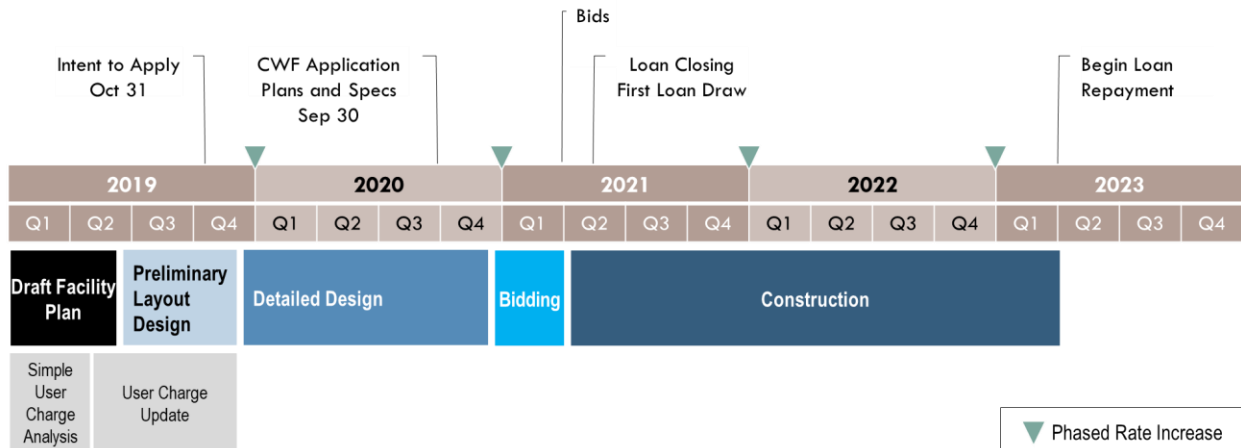


Figure 2 – Implementation Schedule

Financial Plan

The City has been preparing for this major improvement for several years. Prior to this facility plan, many routine capital projects (clarifier rehabilitation and digester cover repairs) have been cash funded over the past several years without increasing sewer utility rates. During this time (the last 5-10 years) the City has projected a major capital project on the Capital Improvements Plan for phosphorus and solids estimated from \$10 million to \$60 million in 2014. As identified above, the recommended near-term projects sum to approximately \$50 million, which include the historical projections for phosphorus and solids as well as other long-overdue energy and reliability improvements to avoid another major upgrade in the foreseeable future. The total project costs can be broken down into these key categories as summarized in Figure 3.

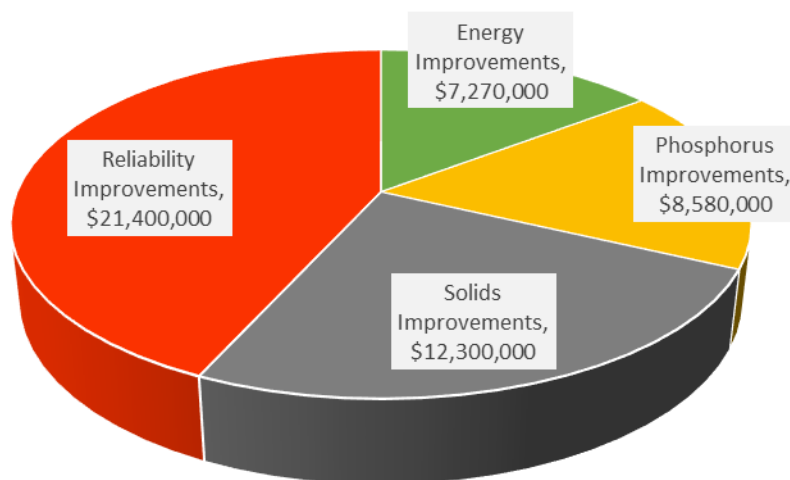


Figure 3 – Project Categories

Implemented as one main project, this is recommended to be financed with a Wisconsin Department of Natural Resources (WDNR) Clean Water Fund (CWF) Loan. These loans are available from revolving funds loaned and paid back from other utilities in the state. CWF loans also can include subsidies for

specific users based on the community’s application score due to affordability, regionalization, and phosphorus improvements. Conservatively, these potential grants were not included at this time. The WDNR Environmental Loans department applies a parallel cost ratio, which reduces the effective interest rate subsidy based on future development, industrial, and government user projections.

Assuming the project is fully financed by the CWF, the annual revenue required to cover debt service can be estimated, assuming current rates are adequate for current treatment costs. The implementation schedule in Figure 2 highlights a few traditional moments to introduce a phased rate increase for a project of this size. This enables the users to become accustomed to the rate change gradually, as many industrial stakeholders may have long-term contracts that restrict their ability to recoup rate increases. Secondly, adjusting rates incrementally, enables the City to control the final rates as the project team refines project costs through planning, design, and construction.

Figure 4 provides a general breakdown of revenue from customers as presented in a 2014 rate review. Overall, revenue is obtained from the following main categories identified in TM1:

- City of La Crosse Sewer Customers
- Major Commercial and Industrial Customers
 - City Brewery
 - Kwik Trip Dairy
 - Great Lakes Cheese
 - Trane Company
- Partner Municipalities
 - City of Onalaska
 - City of La Crescent, MN
 - Town of Campbell
 - Town of Shelby Sanitary District 1
 - Town of Shelby Sanitary District 2

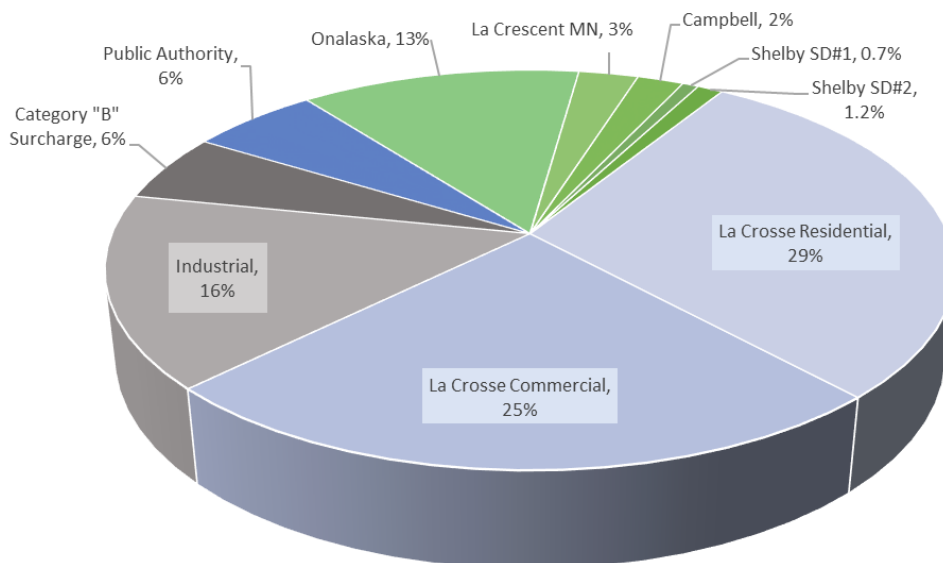


Figure 4 – Revenue From Customers

Financing from the CWF requires 110% debt coverage obtained through sewer fee revenues. To simplify the rates and provide an assessment of the typical residential connection, the following assumptions were used:

- 45,400 gallons of water consumed per year (equivalent to 15 CCF/quarter)
- 1.98% interest rate

For the proposed \$50 million project, the rates would increase approximately \$5.87/month, from \$11.38/month to \$17.24/month.

Figure 5 presents this proposed residential rate graphically to demonstrate the sensitivity to rates based on the final cost of the recommended project. Although this rate increase is significant, the final cost for sewer services at the La Crosse WWTP remains the one of the lowest utilities among similar sized facilities. Rates of similar facilities compared to current and proposed La Crosse sewer rates is presented in Figure 6.

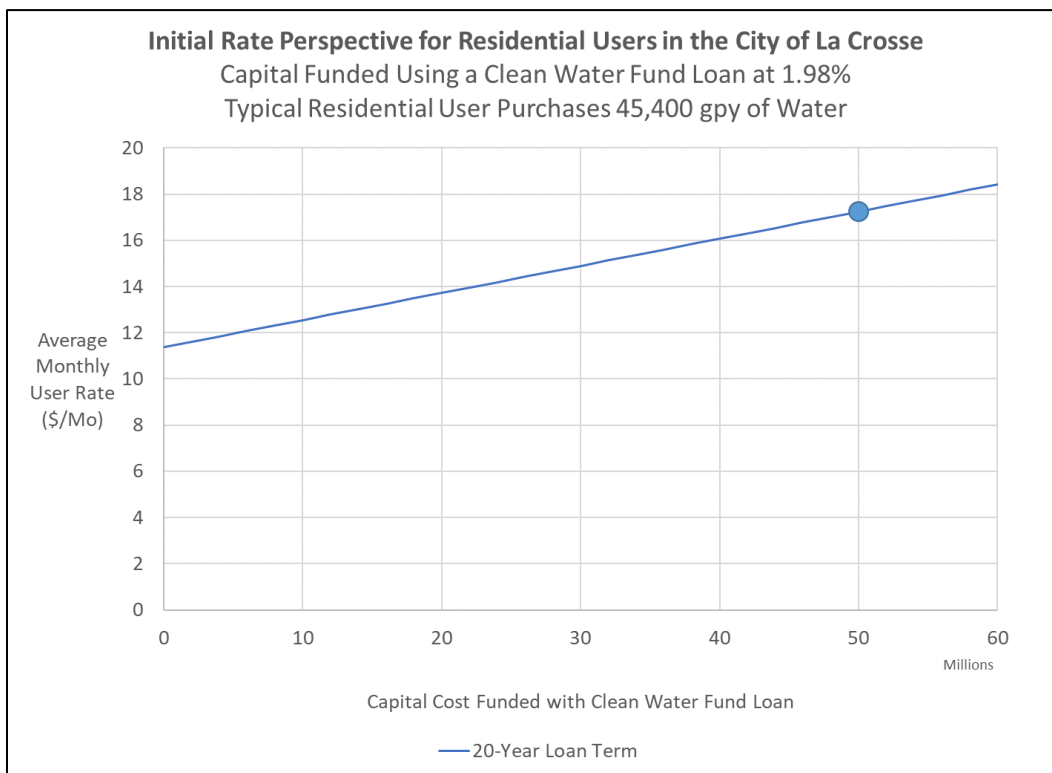


Figure 5 – Proposed Residential Sewer Rate

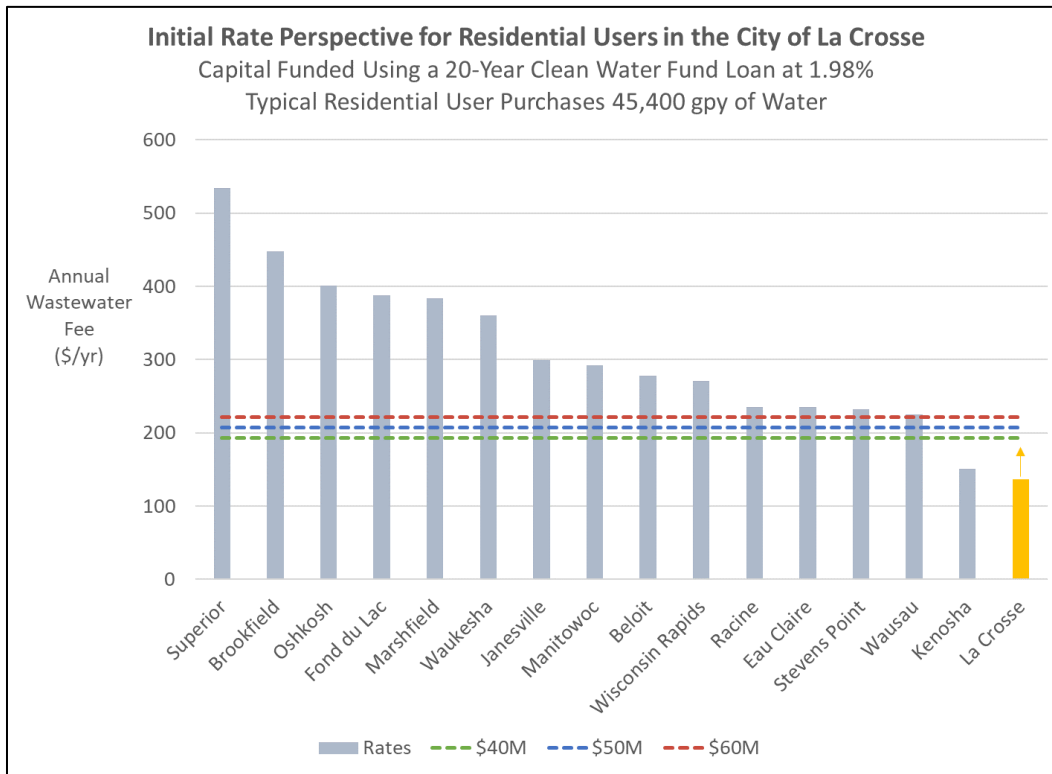


Figure 6 – Residential Sewer Rate Comparison

The proposed rate evaluation presented is a coarse determination and should be followed up with a formal rate study once stakeholder buy-in of the recommended project is obtained. Additionally, the formal rate study should consider the proportion of rates attributed to flow, biological oxygen demand (BOD), total suspended solids (TSS), ammonia, and phosphorus such that appropriate cost allocations or rate structures can be identified for equitable rates from all stakeholders.