City of La Crosse
Sanitary Sewer Utility
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City of La Crosse
Sanitary Sewer Utility
Preliminary Phosphorus Compliance Plan

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ABBREVIATIONS

A2O	Anaerobic Aerobic Oxic
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.

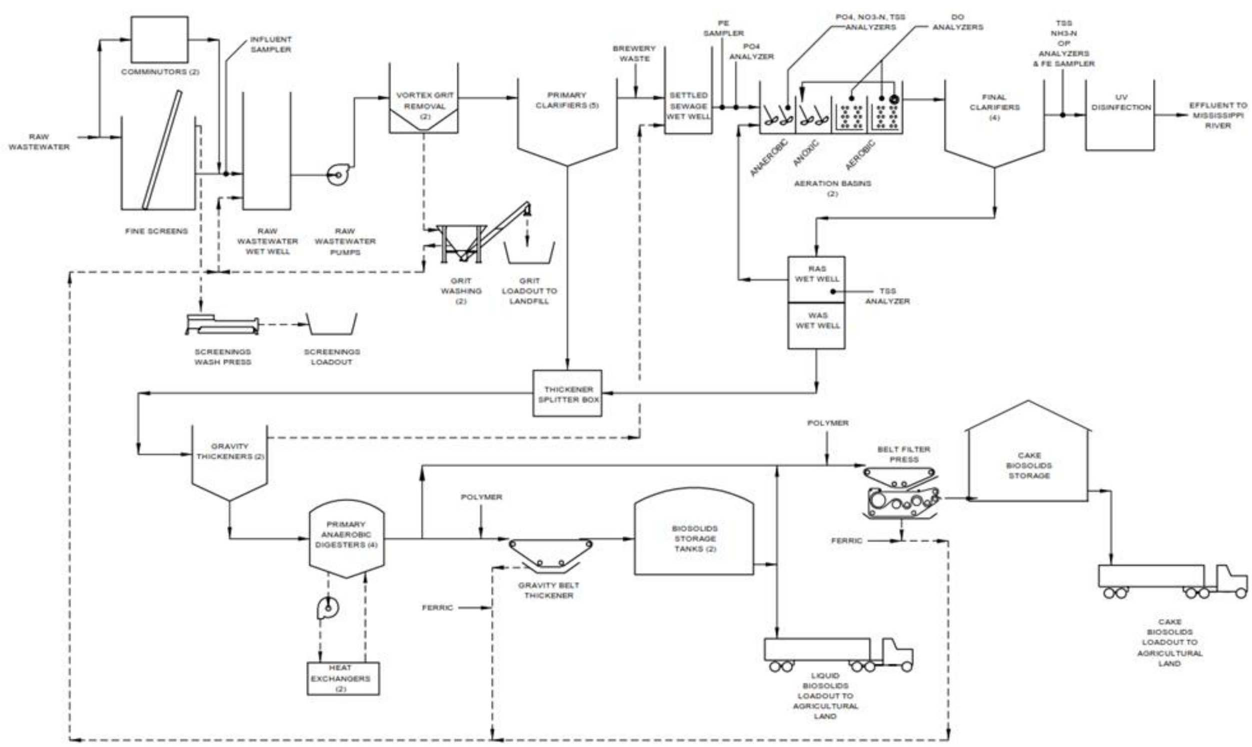

Figure 1 - Isle La Plume WWTP Flow Schematic

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 Village 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 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 an 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.

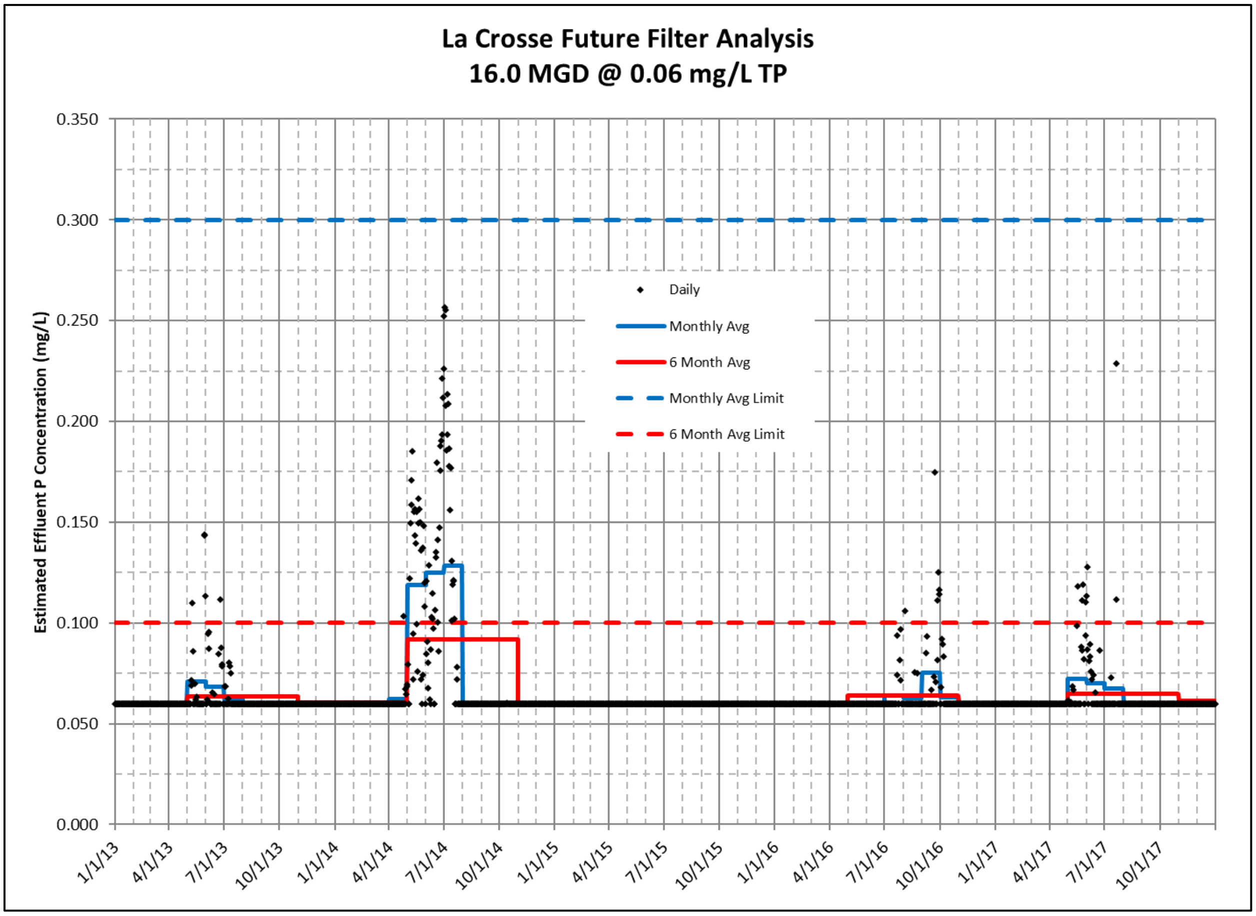

Figure 4-1 Effluent Filter Sizing Estimated Performance

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

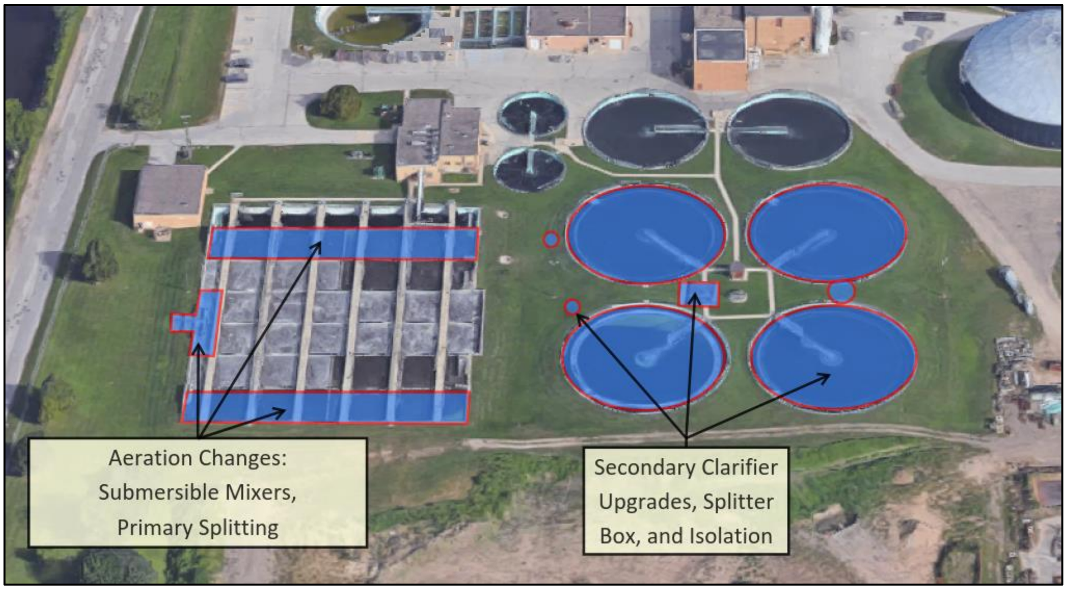

Figure 4-2 Alternative 1 Site Layout

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
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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
Demoltion	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**

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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			
Demoltion				**0**

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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**

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
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AS-2 Large Blade Submersible Selector Mixers

INITIAL COST ESTIMATE

General Description
This alternative shows the costs associated with converting the current subermisble 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
Demoltion	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
Frieght	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
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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			
Demoltion				**0**

City of La Crosse - Wastewater Treatment Plant
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La Crosse, WI

AS-2 Large Blade Submersible Selector Mixers

ANNUAL O&M COST ESTIMATE

General Description	**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

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
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
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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
Demoltion	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
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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			
Demoltion				**8,000**

City of La Crosse - Wastewater Treatment Plant
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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**

City of La Crosse - Wastewater Treatment Plant
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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
Demoltion	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**

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			
Demoltion				**0**

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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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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
Demoltion	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
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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			
Demoltion				**0**

City of La Crosse - Wastewater Treatment Plant
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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**

City of La Crosse - Wastewater Treatment Plant
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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 ciruiting 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
Demoltion	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
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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			
Demoltion				**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	
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**

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.

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
Demoltion	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
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			
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			
Demoltion				**0**

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan
La Crosse, WI

AS-3 Modified UCT

ANNUAL O&M COST ESTIMATE

General Description	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

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
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
Demoltion	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**

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			
Demoltion				**0**

City of La Crosse - Wastewater Treatment Plant
Preliminary Compliance Alternatives Plan

La Crosse, WI

EP-1a Cloth Disk Filter with Coagulation Zones

ANNUAL O&M COST ESTIMATE

General Description	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

General Description	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

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
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**

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.

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
Demoltion	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**

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			
Demoltion				**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**

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
Demoltion	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			
Demoltion				**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

General Description	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

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
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 opflow 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
Demoltion	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**

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			
Demoltion				**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

ITEM	Units	Annual Quantity	Unit Cost ($)	Annual Cost ($)
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**

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
Demoltion	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			
Demoltion				**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**