ENERGY SERVICES PROPOSAL

City of Camas
Wastewater Treatment Plant
Energy Efficiency Upgrades

Presented by:

Abacus Resource Management Company
12655 SW Center Street, Suite 250
Beaverton, Oregon 97005

Contact: Steve Rubbert
SteveR@AbacusRM.com
503-936-6526

ABACUS
RESOURCE
MANAGEMENT
COMPANY

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EXECUTIVE SUMMARY

Abacus Resource Management Company (Abacus) is pleased to present this proposal for the implementation of energy efficiency upgrades at the City of Camas Wastewater Treatment Plant.

This Proposal follows the outline contained in the Conditions of the Master Energy Services Agreement No. 2013-133 A (1). As such, it presents the contractual terms under which Abacus, the City of Camas, and the State of Washington will work together over the term of the project. This agreement describes the services rendered, payment methods, guarantees, and other aspects of the project.

An estimated $123,265 in Clark Public Utility District incentives are expected for this project. In addition, Abacus has assisted the City of Camas in applying for the Washington State Department of Commerce Energy Efficiency Grant Program for the 2013-2015 biennium. Single grants may be obtained up to $500,000 for local agencies.

Description of the Project

The project scope of work consists of upgrades to the ultraviolet (UV) control systems and the aeration system controls to allow automated variation of the power utilized to match the plant loads.

Scope of Services

The scope of services under this Proposal includes the design, construction, and commissioning of the proposed measures and the verification of savings.

Financial Benefits

The project will produce an estimated $22,104 annually in utility savings as described in the Investment Grade Audit (IGA).

Guarantees

Abacus is providing three guarantees under this Proposal. First, we are guaranteeing the Maximum Project Cost as defined in paragraph IV will not exceed $406,176. Second, Abacus is guaranteeing that the City of Camas realizes actual energy/utility savings of not less than 387,013 kWh, which at the baseline utility rates (as defined in the Energy Audit), represents an annual cost savings of $17,977. Third, we are guaranteeing the energy equipment will perform at or above the levels of service defined in Paragraph VI.

In addition to these guarantees, we will provide the City of Camas an “open book” process regarding the actual construction costs. If the actual construction costs are less than we forecast, the City of Camas will realize the financial savings. City representatives will be invited to review the quotes and/or bids from subcontractors and interview the subcontractors to be used on this project.

Project Summary

Total Estimated Project Cost (including all fees and taxes)	$473,294
Maximum Guaranteed Project Cost (total less DES fees and taxes)	$406,176
Guaranteed Energy Savings (at current rates)	$ 17,977
Annual total kWh guaranteed	387,013
Estimated Clark PUD incentive	$123,265

I. FACILITY DESCRIPTION

The Camas Wastewater Treatment Plant, located in Camas, WA treats municipal wastewater for the City of Camas, with a population of approximately 20,000. While the wastewater flows 24 hours a day through this plant, all year; the rate of water flow varies from less than 1 MGD (million gallons / day) to 8 MGD. Two of the water treatment processes were evaluated for energy saving opportunities in this report – (1) is the process of adding oxygen to three settling tanks in order to maintain the proper water chemistry for the biological activation, and (2) is the process of applying ultraviolet (UV) light to the water as the last stage of treatment.

Oxygen is delivered through a 150-hp low pressure blower system, which operates 24 hours a day without the ability to automatically stage down power usage during times of light load. This results in excessive electrical energy usage.

UV light is applied with a series of 384 lamps rated for 33.6 kW. The UV lights operate 24 hours a day without the ability to automatically stage down power use during times of light load, resulting in excessive electrical energy usage. In addition, newer high efficiency UV lamps are available that can reduce the full load power, and provide improved step control through dimming ballasts.

Abacus was contracted by Clark Public Utilities and the Bonneville Power Administration (BPA) to provide a project assessment of the energy efficiency opportunities associated with the blower system and UV system at the Camas Wastewater Treatment Plant. Three years of historical operational data from the plant's data historian (SCADA) system, coupled with input from plant personnel on typical operations were utilized to complete the analysis.

For more details about the existing buildings see the Detailed Energy Audit presented in Appendix B.

II. ESCO EQUIPMENT

The overall scope of the work is the following:

EEM 1: Optimize UV System Controls

This measure incorporates leaving the existing UV system in place and optimizing the controls. The current controls keep the UV system operating at full load 24 hours a day, regardless of the actual load on the system. By optimizing the controls, the power draw of the exiting UV system can vary based upon the actual load. This measure consists of the following:

- Leave the existing UV system in place (Trojan 3000 system)
- Install a new Controller that will incorporate plant effluent flow rate into the UV controller and vary the UV power output based upon the actual UV demand (which is proportional to the effluent flow)

Specific tasks will include:

1. Provide all required permits and inspections.
2. Leave the four existing banks of UV lamps in place.
3. Install new UV controls with an input for the plant flow rate.
4. Program the controls so that only the minimum number of banks of UV lamps are used to properly disinfect the actual flow.
5. Commission system to ensure proper system operation.
6. Provide operator training on all systems.

EEM 3: Optimize Blower System Controls

This measure incorporates leaving the existing Blowers and valves in place and optimizing the controls of the existing Blower system. The current controls are not automatically varying the individual control valves on the tanks, so the valves are set in manual fixed positions that are occasionally, manually adjusted. The current controls also control the blowers to operate at the required speed to maintain the pressure setpoint – and the pressure setpoint is manually adjusted by operators up to several times a day to vary the flow of air through all of the valves at the same time. The operators do not work 24 hours a day and they have limited ability to optimize energy use because the valves are not automatically varying to their individual loads, which do vary. This measure proposes to automate the control of the nine air valves so they modulate as needed to maintain the dissolved oxygen (DO) setpoints. This measure will then incorporate a variable pressure setpoint control strategy so that the lowest pressure will be generated by the blowers in order to satisfy the DO setpoints. By incorporating feedback loops, optimizing the valve operation, and optimizing the pressure setpoint of the blower system the energy use of the blowers can be minimized. This measure consists of the following:

- Replace (4) of the existing VFDs with new VFDs (mounted in the Electrical Room)*
- Leave the (4) existing Blowers and their individual controllers in place (mounted on the blowers)
- Leave the Blower Master Controller in place (mounted in the Electrical Room), and replace failed equipment / components as necessary
- Leave the Rotork Valve Controller in place (mounted in the Electrical Room) and replace failed equipment as necessary*
- Troubleshoot and reprogram as needed the Rotork Valve controller so that each valve automatically modulates to maintain the dissolved oxygen pressure setpoint for that individual tank.*
- Troubleshoot and reprogram as needed the Blower Master Controller so that the system pressure setpoint automatically resets downward when all the valves are less than 80% open, and it automatically resets upward when one of the valves is more than 90% open.
- Troubleshoot the oxygen flow meters and the SCADA total plant oxygen flow calculation so that they are within 10%.

* Rotork valve replacement and replacement VFD line filters are not included in the cost estimate of this proposal. Any remaining construction funds and contingency may be utilized towards replacement of these components as necessary. If additional funds are required to replace Rotork valves, actuators, controls or line filters the City of Camas will need to add the additional funding by change order.

Specific tasks will include:

1. Provide all required permits and inspections.
2. Supply and install (4) new blower VFDs
3. Repair the SCADA system to automatically control the blowers and individual Rotork valves to maintain the DO setpoints in each control zone.
4. Commission controls to establish optimum operational performance.
5. Provide Owner training on modifications.
6. Supply Operation & Maintenance manuals, as applicable.

III. ESCO SERVICES

ESCO will provide the following services:

A. CONSTRUCTION SERVICES

1. Construction: Provide, or cause to be provided, all material, labor, and equipment, including paying for permits, fees, bonds, and insurance, required for the complete

and working installation of the ESCO equipment, except as noted. The ESCO intends to solicit construction costs from selected subcontractors and equipment suppliers who will competitively acquire all material, labor and subcontractors, except the following tasks will be completed by ESCO's own staff:

a) Field Superintendent: onsite supervision of the work.

When ESCO has completed the installation of the Equipment, including start-up and operation verification and training in accordance with the Proposal, ESCO shall provide to Owner a "Notice of Commencement of Energy Savings" and Owner shall have 14 days within which to accept or challenge the Notice.

2. Performance Verification: Complete the M&V protocols outlined in the Energy Audit and work with Clark PUD and the Owner to document the savings upon which the utility incentives will be based.

3. Performance Maintenance: The ESCO will monitor system performance and will review expected performance and actual performance with the Owner on a quarterly basis during the first year following the commencement of energy savings and thereafter annually through the term of the performance guarantee.

4. Equipment Maintenance: The ESCO will provide no equipment maintenance other than warranty services. Following the completion of the installation and Owner acceptance of the Equipment, Owner shall provide all necessary service, repairs, and adjustments to the Equipment so that the Equipment will perform in the manner and to the extent set forth in the Proposal. ESCO shall have no obligation to service or maintain the Equipment after Completion and Acceptance unless ESCO and Owner have entered into a separate maintenance agreement. ESCO shall coordinate manufacturer's standard warranty on equipment and materials.

5. Hazardous Waste: ESCO intends to notify the Owner of all locations where the work may encounter hazardous materials and request the Owner abate the hazard prior to the work. However, upon the request of Owner, ESCO may, without assuming the ownership thereof and acting in the name and on behalf of the Owner, have the hazardous material or substances removed and disposed of or contained and the cost of such work is not included in the project. Owner agrees and acknowledges that it has not relied on or employed ESCO to analyze or identify the presence of any hazardous substance on the Owner's premises.

6. Operation and Maintenance Measures: None.

7. Warranty: ESCO will respond to and correct all warranty claims initiated by the Owner for a period of one year following the "Notice of Commencement of Energy Savings."

B. PROFESSIONAL SERVICES

1. Project Management: Overall development and management of the project throughout the term of the agreement. Specific tasks include project development, management of Owner/Designer issues, Management of Owner/Constructor issues, and management of warranty issues. ESCO will keep Owner informed on project status via regular emails and project meetings. ESCO will issue formal meeting minutes of all meetings.

2. Energy Audit: Detailed engineering analysis to establish scope and feasibility of conservation measures.

3. Design Services: Provide sketches, material lists, drawings, specifications, and/or other documentation which may be required for Owner's review and to obtain permits and negotiate or receive competitive prices for construction of the ESCO equipment. Design services include all mechanical and electrical design required for the project. Specific tasks will include:
   a. Collect record drawings and conduct site surveys.
   b. Meet with Owner to determine design standards.
   c. Preliminary design submittal and review.
   d. Final design submittal and review.
   e. Negotiating & Bidding (including document reproduction and distribution).
   f. Contractor interviews and selection.
   g. Submittal/shop drawing review.
   h. As-built drawing preparation as applicable.
   i. Six month and one year warranty inspections.

4. Construction Management: Provide construction management services to coordinate and supervise the work. Specific tasks will include:
   a. Execute all subcontracts.
   b. Secure all required bonds, permits, and insurance coverage.
   c. Coordinate and control the construction schedule.
   d. Maintain complete and accurate project accounting records including invoicing.
   e. Coordinate and control all construction activities.
   f. Execute project closeout.
   g. Resolve all warranty claims.

   The owner is expected to coordinate day-to-day communications with system operators and any scheduling of affluent relocations in and around the work.

5. Start-Up, Testing and Operation Training: The ESCO will provide:
   a. Complete start-up, testing, and commissioning of ESCO equipment.
   b. Training of building staff to perform basic adjustments and scheduling of the affected equipment.

6. Ongoing Services: For a period one year following the “Notice of Commencement of Energy Savings” the ESCO will provide:
   a. Remote monitoring, quarterly reporting, and meetings as needed to address concerns related to actual performance of the ESCO equipment.
   b. Coordination with subcontractors and suppliers as required to resolve warranty claims made by Owner.

   For an additional two year period, the ESCO will provide:
   a. Remote monitoring, annual reporting, and meetings as needed to address concerns related to actual performance of the ESCO equipment.

IV. PROJECT COSTS

A. ESCO guarantees that the Maximum Project Cost for scope items listed in paragraph II will not exceed $406,176 (all costs are **not** including sales tax). In addition to these costs which are included in the agreement, there are costs budgeted outside the agreement for sales tax and DES project management fee ($67,118 total) bringing the total project budget to $473,294.

B. Maximum Project Cost includes:
1. Construction Services ....$ 278,929
2. Professional Services (ESCO Fees) ....$ 105,994
3. Other Costs (Contingency)…..............................$ 21,253

C. Construction Services: Will be charged at actual costs not to exceed the guaranteed maximum price of $278,929. These costs are estimated as follows:

			Proposed Cost	
A. CONSTRUCTION COSTS				
	Labor and Material:			
EEM-1	UV Controls		$	120,948
EEM-3	Blower Controls		$	50,807
	VFD Replacements		$	101,705
Subtotal Labor and Materials Cost			$	273,460
	Permits (included above)		$	-
	Construction Bond	2.0%	$	5,469
TOTAL CONSTRUCTION COST			$	278,929

Invoicing for the construction services will be on a monthly basis based on percentage of work completed. Invoicing backup data will be provided including schedule of values and corresponding subcontractor invoices or other source of costs.

The ESCO shall provide a Schedule of Values at the end of construction bidding. At a minimum, the schedule shall identify the costs of subcontractors, Abacus direct purchased material, bonds, permits, and direct project expenses.

D. Professional Services: Will be lump sum fees and will be billed as a percentage of completion. The total fee for all professional services is $105,994 which breaks down as follows:

B. PROFESSIONAL SERVICES FEES		
Audit Fee (Amount Paid by Utility)		$ -
Design M,E,C,S	10.0%	$ 27,893
Construction Management	6.0%	$ 16,736
ESCO M and V Cost	2.0%	$ 5,579
Ongoing M&V (Years 2 and 3)	2.0%	$ 5,579
Overhead and Profit	18.0%	$ 50,207
TOTAL ESCO FEES		$ 105,994

E. Energy Performance Monitoring and Verification Fee: Is included in Professional Services Fees above and will be billed at the end of the first year of energy savings (one year after commencement of energy savings). The ongoing M&V fee for years 2 and 3 will be billed at the end of those years as applicable ($2,789.50 per year.)

F. Contingency: Within the Guaranteed Maximum Price, a contingency of $21,253 is available to the ESCO to cover unanticipated costs associated with the work. These additional costs can be added to the agreement via a Change Order request from ESCO. Any unspent contingency will revert to the Owner at project closeout.

G. Other Costs: The following costs are not guaranteed by the ESCO and are listed here for budgetary or funding authorization purposes only:

1. Estimated DES Project Management Fee: $29,000 + $4,000 for 2 years M&V fee = $33,000 total.

2. Sales Tax: sales tax will be charged at the prevailing rate (currently 8.4%) to yield the following estimated tax amounts:

Sales Tax - Construction Portion	$23,430
Sales Tax - Professional Services Portion	$ 8,903
Sales Tax - Contingency Portion	$ 1,785
Total Sales Tax	$34,118

V. PROJECT ACCOUNTING

A. Accounting Records

The ESCO shall check all material, equipment and labor entering into the Work and shall keep such full and detailed accounts as may be necessary for proper financial management under this Agreement. The accounting system shall be satisfactory to the Owner. The Owner shall be afforded access to all the ESCO's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda and similar data relating to this Contract, and the ESCO shall preserve all such records for a period of three years, or for such longer period as may be required by law, after the final payment.

B. Construction Services

Project accounting records will be used for the sole purpose of documenting actual cost of the Construction Services.

C. Reconciliation of Actual Project Costs

1. The guaranteed maximum project cost is based on an estimate of construction services costs. In recognition that actual costs may vary from the estimate, the following procedures are established to reconcile this difference:
    a. When actual costs exceed the estimate and contingency, the additional expense will be borne by the ESCO.
    b. When actual costs are less than the estimate, the remaining funds will be returned to the Owner by executing a deductive change order at project completion.

VI. STANDARDS OF COMFORT SERVICE

A. Heating: Not Applicable
B. Cooling: Not Applicable
C. Ventilation: Not Applicable

VII. ESTIMATED ANNUAL SAVINGS AMOUNT

A. The ESCO estimates that annual utility savings will be 475,874 kWh.

B. The ESCO estimates that annual utility cost savings will be $22,104.

VIII. METHOD OF CALCULATING ENERGY AND ENERGY COST SAVINGS (M&V PLAN)

We will measure and verify the electric energy savings resulting from this project using the IPMVP (International Performance Measurement and Verification Protocol). The electric energy savings for EEM 1 (UV controls) will be based upon IPMVP Option C approach (Building Utility Meter method), and the savings for EEM 2 (Blower controls) will be based upon IPMVP Option A approach (Retrofit Isolation with Key Parameter Measurement).

Annual utility cost ($) savings for both EEMs will be guaranteed at the utility rates currently in effect at the time of this proposal and as documented in the IGA listed in Appendix B.

M&V will be provided for each installed EEM. The equipment installed for each EEM will be verified and documented. To verify EEM performance, the following data will be obtained:

1. Utility bills for the UV Building electric meter
2. Blower current draw for all four blowers
3. Blower discharge pressure
4. Blower total airflow
5. Plant Daily average influent and effluent flow (MGD) and BOD (lb), TSS (lb) Ammonia (lb)

The facility SCADA system and/or portable data loggers will be utilized to obtain the data.

For EEM 1, the energy savings predicted are over 40% of the entire electric meter existing energy usage. Since the predicted savings are much greater than 10% of the entire utility meter existing usage, we propose to use Option C to directly measure the savings for this measure. This method (Option C) is the most cost effective option for this EEM because it will allow us to utilize the existing electric utility meter to measure the energy savings without installing individual sub meters.

Note: If the owner installs additional equipment to this utility electric meter, or if they remove equipment currently connected to this meter, then we will make static adjustments to the M&V approach to take these into account. For instance, if the owner removes a 10 kW load that operates 24 hours a day from this meter, then we will subtract this energy from the baseline energy use, so that we do not claim savings for something that was not part of our upgrade. Likewise if the owner adds a 10 kW load that operates 24 hours a day to this meter, then we will subtract this energy from the post-upgrade energy use, so that the energy savings we measure from the meter is due to the EEM installed.

For EEM 2, the energy savings predicted is not significantly more than 10% of the existing baseline energy used by the meter that serves this building. Therefore IPMVP does not recommended measuring the energy savings directly from the utility meter, because there are other factors that have more impact on the utility meter than the EEM being installed, and because the relative % of savings is too small. We therefore propose to use the IPMVP Option A (Retrofit Isolation with Key Parameter Measurement) to measure the savings for this EEM. We have already directly measured the existing energy used by the equipment affected by this upgrade as part of our energy audit by installing current sensors on each of the four blowers for a one week period. We propose to install current sensors and measure the energy used by these same four blowers after the upgrade, to directly measure the after-upgrade energy used by the blowers. The average power measured will be multiplied by the annual hours of operation to determine the annual energy savings. We propose to install these sub-meters and measure the after-upgrade energy use one time each year throughout the duration of the M&V reporting period.

If there are changes to the way the plant operates it may necessitate further changes to the baseline energy use of these systems. If there is a significant change in the amount of and/or the quality of influent received at this facility it may necessitate a change to the baseline energy use. If there is a significant change in the amount of and/or the quality of effluent sent out from this facility it may necessitate a change to the baseline energy use.

IX. ENERGY COST SAVINGS GUARANTY

The ESCO guarantees that the actual energy/utility savings will not be less than 387,013 kWh, which at the baseline utility rates (as defined in the Energy Audit), represents an annual cost savings of $17,977.

In the event that actual energy cost savings, pursuant to Section VIII Method of Calculating Energy and Energy Cost Savings, are less than this guaranteed minimum, the ESCO shall pay the Owner the difference between the actual cost savings and the guaranteed amount. This savings guarantee will be in effect only for the first 3 years after the commencement of savings unless the Owner executes a separate performance maintenance agreement for additional year(s) of Performance Monitoring and Verification Services.

X. FINANCING

Project financing will be provided by the Owner. The ESCO agrees to waive any finance fees related to the financing of project costs (as described in Section IV) provided the Owner agrees to make monthly progress payments to the ESCO based on the percentage of completion of each task. Progress payments will be less 5% for retention. Retention amounts will be due after project completion per the ESCO Agreement.

XI. INSURANCE AND BONDING

A. The ESCO shall provide a payment and performance bond in the amount of 100% of the Construction Services cost plus applicable sales tax on that cost. The Bond shall be in the form of AIA Document A312. The "Sum Amount of Bond" shall specifically exclude coverage for those portions of the Energy Services Agreement and/or Energy Services Agreement Addendum pertaining to design services, energy cost savings guarantee, maintenance guarantee, utility incentives, efficiency guarantees, and any other clauses which do not relate specifically to construction management and supervision of work for purchasing and installing of ESCO Equipment, or for work to be accomplished by the Owner. The Bond must be with a Surety or Bonding Company that is registered with the State of Washington Insurance Commissioner's Office.

B. For the purposes of this Agreement, the "Sum Amount of Bond" shall be $302,359 ($278,929 construction services plus $23,430 sales tax).

C. Certificates of General Liability insurance will be provided prior to contract signing. The State of Washington shall be named as an additional insured on all insurance certificates.

XII. MODIFICATIONS TO BASELINE BY OWNER

A. The Owner shall maintain all existing facilities and installed ESCO equipment during the term of this contract at or above current maintenance levels. Owner agrees to maintain the energy efficiency of the systems installed.

B. The energy savings are based on operating the energy systems in a similar manner that was represented and logged during our analysis period. In the event the Owner elects to operate the energy systems differently, thereby increasing the energy usage of the system or load in the spaces served, the ESCO will prepare a calculation of the additional energy used for such additional usage and be allowed to adjust the baseline use and savings accordingly.

C. We have assumed that the annual water flow and quality into the plant and out of the plant will not change significantly in the future. If there is a change to the amount of water being processed, or of the quality of water entering or leaving the plant, then we will need to adjust the energy savings to take this into account.

D. We have assumed that the biological treatment processes that are used at this plant will remain the same in the future. If the owner makes significant changes to the way that they process the water, then we will need to adjust the energy savings to take this into account.

XIII. PROJECT SCHEDULE

ESCO proposes the following schedule for completion of design and construction activities:

City of Camas acceptance of ESP	December 15, 2014
ESCO Notice to Proceed	January 9, 2015
Subcontractor Bids Awarded	January 23, 2015
Submittal approval & order materials	February 6, 2015
Construction Begins	April 13, 2015
Construction Substantially Complete	June 26, 2015
Commencement of Energy Savings	July 20, 2015

These dates are preliminary. A more definitive schedule will be produced upon execution of contract documents and equipment selection for lead time.

APPENDICES

The following documents are attached to this proposal and included as part intended to be a part of the proposal:

The Project Financial Tables are included as Appendix A.

The Investment Grade Energy Audit for the Camas Wastewater Treatment Plant is included in this proposal as Appendix B.

APPENDIX A – FINANCIAL TABLES

Budget Summary

Project:	City of Camas - WWTP energy upgrades	Measure:	WWTP Projects	
	Camas, Washington	Date:	12/2/2014	
		Phase:	ESPC Proposal	
A. CONSTRUCTION COSTS			Proposed Cost	
	Labor and Material:			
EEM-1	UV Controls		$	120,948
EEM-3	Blower Controls		$	50,807
	VFD Replacements		$	101,705
Subtotal Labor and Materials Cost			$	273,460
	Permits (included above)		$	-
	Construction Bond	2.0%	$	5,469
TOTAL CONSTRUCTION COST			$	278,929
B. PROFESSIONAL SERVICES FEES				
	Audit Fee (Amount Paid by Utility)		$	-
	Design M,E,C,S	10.0%	$	27,893
	Construction Management	6.0%	$	16,736
	ESCO M and V Cost	2.0%	$	5,579
	Ongoing M&V (Years 2 and 3)	2.0%	$	5,579
	Overhead and Profit	18.0%	$	50,207
TOTAL ESCO FEES			$	105,994
C. OTHER COSTS				
	Project Contingency	5.5%	$	21,253
TOTAL OTHER COSTS			$	21,253
D. TOTAL GUARANTEED CONSTRUCTION & ESCO SERVICES			$	406,176
E. NON-GUARANTEED COSTS				
	Sales Tax - Construction Portion	8.4%	$	23,430
	Sales Tax - Professional Services Portion	8.4%	$	8,903
	Sales Tax - Contingency Portion	8.4%	$	1,785
	DES Admin. Fee		$	29,000
	DES M and V Fee (Years 2 & 3)		$	4,000
TOTAL NON GUARANTEED COSTS			$	67,118
F. TOTAL PROJECT COST			$	473,294

Utility Incentives (Estimate)	$	123,265
Commerce Grant (Estimate)	$	118,323
Net Project Cost	$	231,705
Estimated Annual Utility Cost Savings	$	22,104
Simple Payback (years)	10.5	
Simple Payback (years) without Commerce Grant	15.8	

Camas WWTP - EEM Cost Breakdown

EEM -1

UV Controls

$73,095	WH Reilly quote for new UV Control Panel , Programming, Startup & Labor
$8,800	OCD Quote for SCADA Integration
$2,500	Estimated Wiring costs
$1,000	Estimated Freight Charges
$85,395	TOTAL BASE PROJECT QUOTE (Does not include replacement boards for UV system)

UV Spare Parts

$8,100	WH Reilly quote for (4) Communication Boards (Total of (4) existing)
$2,244	WH Reilly quote for (4) Module Control Boards (Total of (48) existing)
$1,160	WH Reilly quote for (4) Relay Boards (Total of (48) existing)
$5,000	Labor estimate to install any boards that are needed
$19,049	Misc parts & Freight Charges
$35,553	TOTAL Estimated Cost of Spare Parts

$120,948	**TOTAL EEM-1 ANTICIPATED COSTS (Controls and Spare Parts)**

EEM -3

Aeration Controls

$39,600	OCD Quote for OCD Work
$3,185	OR Electric quote for Electrical work needed for OCD scope
$42,785	Option 1 EEM-3 cost estimate

$50,807	**Alternate quote from Control Engineers (turn key)**

VFD Replacements

$77,917	EC Quote for (4) VFDs
$6,600	RD estimate of SCADA integration
$17,188	Additional installation, wiring costs and replacement equipment
$101,705	**Estimated cost of VFD replacements**

APPENDIX B – INVESTMENT GRADE AUDIT

Project Assessment Report
Camas Wastewater Treatment Plant

Presented to: Eric Levison – Public Works Director, City of Camas

Facility located at
1129 SE Polk St,
Camas, WA 98607

Sponsored by:

Energy Smart Industrial
BPA ENERGY EFFICIENCY

and

Clark Public Utilities

Submitted by:

ABACUS

12655 SW Center Street, Suite 250
Beaverton, OR 97007

TSP Project Number: #0374
10/08/14

Disclaimer

The intent of this Project Assessment report is to estimate energy savings associated with recommended Energy Efficiency Measures (EEMs). Appropriate detail is included in Sections 2-4 of this report. However, this report is not intended to serve as a detailed engineering design document. It should be noted that detailed design efforts may be required in order to implement the recommended upgrades. As appropriate, costs for those design efforts are included as part of the cost estimate for each measure.

While the recommendations in this report have been reviewed for technical accuracy and are believed to be reasonably accurate, the findings are estimates and actual results may vary. As a result, Abacus, Clark Public Utilities, and the Bonneville Power Administration (BPA) are not liable if estimated savings or economics are not actually achieved. All savings and cost estimates in the report are for informational purposes, and are not to be construed as a design document or as guarantees.

The City of Camas should independently evaluate any advice or direction provided in this report. In no event will Abacus, Clark Public Utilities, and/or BPA be liable for the failure to achieve a specified amount of energy savings and any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Contacts & Preparation

<u>Facility Contact:</u>
Bob Busch
Wastewater Operations Supervisor
1129 SE Polk St
Camas, WA 98607
Phone: (360) 834-3263
Email: **bbusch@cityofcamas.us**

<u>Utility Contact:</u>
Colleen Peterson
P.O. Box 8900
Vancouver, WA 98668
Phone: (360) 992-3303
Email: **cpeterson@clarkpud.com**

<u>BPA ESIP Contact</u>:
Eli Ricondo
123 NE 3rd Avenue, Suite 400
Portland, OR 97232
Phone: (360) 580-6892
Email:
eli.ricondo@energysmartindustrial.com

<u>BPA Water/Wastewater Contact:</u>
Dawn Lesley
331 W 13th Ave, Suite F
Eugene, OR 97401
Phone: (971) 202-1625
Email:
dawn.lesley@energysmartindustrial.com

<u>TSP Consultant Contact:</u>
This report was prepared by:
Abacus
Rich Davis
12655 SW Center Street, Suite 250
Beaverton, OR 97007
Phone: (503) 936-7163
Email: **richd@abacusrm.com**

Contents

1 EXECUTIVE SUMMARY

1.1 Introduction

The Camas Wastewater Treatment Plant, located in Camas, WA treats municipal wastewater for the City of Camas, with a population of approximately 20,000. While the wastewater flows 24 hours per day through this plant, all year; the rate of water flow varies from less than 1 MGD (million gallons / day) to 8 MGD. Two of the water treatment processes are evaluated for energy saving opportunities in this report – 1) is the process of adding oxygen to three aeration basins in order to maintain the proper conditions for the biological treatment, and 2) is the process of applying ultraviolet (UV) light to disinfect the water as the last stage of treatment.

Oxygen is delivered through a low pressure aeration system, which operates 24 hours per day without the ability to automatically stage down power usage during times of light biochemical oxygen demand (BOD) load. This results in excessive electrical energy usage.

UV light is applied with a series of 384 lamps rated for 33.6 kW. All of the UV lamps operate 24 hours per day without the ability to automatically stage down power use during times of low flow, resulting in excessive electrical energy usage. In addition, newer high-efficiency UV lamps are available that can reduce the full load power, and provide improved step control through dimming ballasts.

Abacus was contracted by Clark Public Utilities and the Bonneville Power Administration (BPA) to provide a project assessment of the energy efficiency opportunities associated with the aeration system and UV system at the Camas Wastewater Treatment Plant. Three years of historical operational data from the plant's data historian (SCADA) system, coupled with input from plant personnel on typical operations was utilized as part of this analysis.

The City of Camas should notify Clark Public Utilities or its Energy Smart Industrial Partner (ESIP) if it intends to implement any of the efficiency measures outlined in this report. Your utility and ESIP are responsible for obtaining approval for incentives. Once Clark Public Utilities approval has been granted, the City of Camas is free to place equipment orders or make other financial commitments to implement efficiency measures.

1.2 Summary of Findings and Recommendations

Multiple individual energy efficiency measures (EEMs) have been considered for the aeration and UV processes. Below is a brief description of each measure. More detailed descriptions can be found in Section 2.

EEM 1: Optimize UV System Controls: This measure recommends leaving the existing UV system in place and optimizing the controls. The current controls keep the UV system operating at full load 24 hours per day, regardless of the actual flow through the system. By optimizing the controls the power draw of the existing UV system can vary based upon the actual flow. This measure consists of the following:

- Leave the existing UV system in place (Trojan 3000 system)

- Install a new Controller that will incorporate plant effluent flow rate data into the UV controller and vary the UV power output based upon the actual UV demand (proportional to the effluent flow)

EEM 2: Install New UV System and Optimize UV System Controls: This measure recommends replacing the existing UV system with a new high efficiency system and optimizing the controls. The existing UV system consumes about 32 kW at full load. The proposed new UV system consumes about 17 kW at full load. New controls are required that incorporate feedback loop so that the controls will automatically vary the power of the UV system based upon the actual influent flow, instead of operating at 100% power 24 hours per day. This measure consists of the following:

- Remove the existing UV system (Trojan 3000) and install a new high-efficiency UV system (Trojan 3000Plus)
- Install a new Controller that will incorporate plant effluent flow rate data into the UV controller and vary the UV power output based upon the actual UV demand (proportional to the effluent flow)

EEM 3: Optimize Aeration System Controls: This measure recommends leaving the existing blowers and valves in place and adding automated controls to use "most open valve" control strategy. The current controls only vary blower speed to maintain a pressure setpoint, leaving valves set in manual, fixed positions that are only occasionally manually adjusted. The existing blowers operate at the required speed to maintain a pressure setpoint – and the pressure setpoint is manually adjusted by operators up to several times a day to vary the flow of air through all of the valves at the same time. hours per day. The facility is staffed by operators approximately 12 hours per day and the operators have limited ability to optimize energy use. This measure would automate the control of the nine air valves so they modulate as needed to maintain required dissolved oxygen (DO) setpoints. By incorporating feedback loops, optimizing the valve operation, and continuously optimizing the pressure setpoint of the aeration system the energy use of the blowers can be minimized. This measure consists of the following:

- Leave the (4) existing VFDs in place (mounted in the Electrical Room)
- Leave the (4) existing blowers and their individual controllers in place (mounted on the blowers)
- Leave the Blower Master Controller in place (mounted in the Electrical Room), and replace failed equipment/components as necessary
- Leave the Rotork Valve Controller in place (mounted in the Electrical Room) and replace failed equipment as necessary
- Troubleshoot and reprogram as needed the Rotork Valve controller so that each valve automatically modulates to maintain the dissolved oxygen pressure setpoint for that individual tank
- Troubleshoot and reprogram as needed the Blower Master Controller so that the system pressure setpoint automatically resets downward when all the valves are less than 80% open, and it automatically resets upward when one of the valves is more than 90% open.
- Troubleshoot the airflow meters and the SCADA total plant airflow calculation so that they are within 10%

1.2.1 Recommendations

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Abacus recommends the implementation of EEMs 1 and 3. These recommended measures reduce existing facility-wide energy use by over 25% and produce a simple payback of about 4 years after the incentives from Clark Public Utilities and BPA.

In the future the owner should evaluate the potential energy savings that can be achieved by new high efficiency blower(s) sized appropriately for actual BOD and ammonia load, instead of replacing any existing blowers with similar blowers. Energy savings of 10%-35% may be possible for a new high-efficiency blower.

1.3 Economic Summary

Table 1: Savings and Cost Summary

Cost of Energy:	$0.046 /kWh

EEM No.	Description	Include in Package?	Annual Energy Savings (kWh/yr)	Annual Energy Cost Savings ($)	Cost Eligible for Incentives ($)	Pre-Incentive Payback (yrs)
1	Optimize UV System Controls	Yes	204,023	$9,477	$122,745	13.0
2	Install New UV System and Optimize UV System Controls	No	215,464	$10,008	$276,333	27.6
3	Optimize Aeration System Controls	Yes	271,851	$12,627	$53,347	4.2
TOTALS FOR RECOMMENDED MEASURES			**475,874**	**$22,104**	**$176,092**	**8.0**

Table 2: Incentive Summary

Energy Incentive Rate	$0.25 /kWh
Incentive Cap, % of Project Cost:	70% /kWh
Busbar Energy Savings Factor	1.09056

EEM No.	Description	Utility/BPA Incentive Calculation: Incentive Cap, Project Cost ($)	Incentive Cap, Energy Savings ($)	Final Incentive ($)	Cost After Incentive ($)	Final Payback (yrs)
1	Optimize UV System Controls	$85,922	$55,625	$55,625	$67,120	7.1
2	Install New UV System and Optimize UV System Controls	$193,433	$58,744	$58,744	$217,588	21.7
3	Optimize Aeration System Controls	$37,343	$74,117	$37,343	$16,004	1.3
TOTALS FOR RECOMMENDED MEASURES		**$123,265**	**$129,742**	**$123,265**	**$83,124**	**3.8**

Fraction of Project Cost Covered by Utility/BPA Incentives:	70.0%

1.4 Implementation Summary

Clark Public Utilities and BPA must approve the EEMs specified in this report to be eligible for incentives. Clark Public Utilities and BPA approval is highly recommended prior to placing equipment orders or making other financial commitments to implement EEMs in order to be eligible for incentives.

1. *Review this report and make an implementation decision.* Your staff has assisted in the development of this report. Because equipment and operational changes are recommended, your organization needs to be comfortable with the data, the analysis and the proposed EEMs for the project to be a success. The City of Camas should independently evaluate the information contained in this report as you normally would for other projects of this scope. Contact vendors to firm up bids. Do your normal diligence and make a decision.

2. *Notify your utility or ESIP of your implementation decision.* Contact your utility or ESIP with your implementation decision. The contact information for your utility and ESIP has been included with this report. Your utility and ESIP are responsible for obtaining utility and BPA approval for EEM incentives.

3. *Obtain approval from your utility and BPA for incentives.* Your utility or ESIP will notify you when utility and BPA approval has been obtained. You may be required to sign an incentive agreement with your utility as part of this process. It is suggested to obtain utility and BPA approval prior to placing an equipment order or making other financial commitments to implement EEMs.

4. *Obtain approval for any other project incentive.* You are free to apply for additional incentives, grants, or tax credits that may be available for the project. Your utility and ESIP are available to assist in this process.

5. *Implement the project.* Finalize the design in a manner consistent with equipment, set-points, and algorithms described in Section 2 of this report. Any significant differences should be discussed with your utility or ESIP to confirm that they do not have a negative impact on energy efficiency performance. Sign purchase orders and contracts with contractors. Complete the installation.

6. *Track project costs.* All project costs must be documented and supported to receive incentives. Maintain records of all project costs (invoices, etc.) and ensure that project costs eligible for incentives can be clearly identified and are not bundled with other costs that are not eligible for incentives.

7. *Notify your utility or ESIP when project implementation is complete.* Contact your utility or ESIP when project implementation is complete, online, and operating in a steady state manner.

8. *Assist in the preparation of the project completion report.* Approval of a project completion report by your utility and BPA is required before the project incentive is issued. Your utility and ESIP are responsible for managing the development of the completion report. In most cases, the Technical Service Provider (TSP) consultant that provides the project assessment report will be utilized for the completion report. Funding of the TSP consultant for the completion report is available upon BPA approval. BPA may require you to share a portion of the TSP consultant cost. As part of the completion report development, you will be asked to provide documentation of all project costs that you are seeking incentives for. The completion report will also include Measurement and Verification (M&V) and commissioning of the project. Your assistance may be necessary in the M&V and commissioning efforts.

2 DETAILED DESCRIPTION: PROPOSED EQUIPMENT/OPERATION

2.1 EEM 1 – Optimize UV System Controls

2.1.1 EEM 1 – Source of Energy Savings

Only operate as many of the UV banks as needed for proper disinfection.

All four of the UV banks are operating 24 hours per day. Based on data provided by the manufacturer of these UV banks, at lower plant flows fewer banks are needed. By turning off banks of UV lamps electricity will be saved.

2.1.2 EEM 1 – Specific Equipment Recommendations

- Leave the four existing banks of UV lamps in place
- Install new UV controls with an input for the plant flow rate
- Program the controls so that only the minimum number of banks of UV lamps are used to properly disinfect the actual flow

2.1.3 EEM 1 – Setpoints and Algorithms Recommended to Achieve Energy Performance

- The following is a guide to the initial operation of the four UV banks

Trojan Mfr Data Table		
Flow (MGD)	# of Banks Needed	UV 3000 Power (kW)
10	3	25.2
9	3	25.2
8	2	16.8
7	2	16.8
6	2	16.8
5	2	16.8
4	1	8.4
3	1	8.4
2	1	8.4
1	1	8.4

2.2 EEM 2 – Install New UV System and Optimize UV System Controls

2.2.1 EEM 2 – Source of Energy Savings

Install new UV lamps that use lower wattage to provide the same disinfection as the existing system. Only operate as many of the UV banks as needed for proper disinfection.

Based on data provided by the manufacturer of these new UV banks, lower wattage is required at all flows and these lamps will be variable output, providing increased control levels than the existing system. By turning off banks of UV lamps electricity will be saved, and by lowering the output of a bank electricity will be saved.

2.2.2 EEM 2 – Specific Equipment Recommendations

- Remove the four existing banks of UV
- Install two new banks of UV, high efficiency style, rated for approximately 17 kW of power at 10 MGD
- Install new UV controls with an input for the plant flow
- Program the controls so that only the minimum number of banks of UV lamps are used to properly disinfect the actual flow

2.2.3 EEM 2 – Setpoints and Algorithms Recommended to Achieve Energy Performance

- The following is a guide to the initial operation of the new UV system

Trojan Mfr Data Table	
Flow (MGD)	UV 3000PLUS Power (kW)
10	16.8
9	15.1
8	14.3
7	12.6
6	12.6
5	10.1
4	8.8
3	7.1
2	6.3
1	6.3

2.3 EEM 3 – Optimize Aeration System Controls

2.3.1 EEM 3 – Source of Energy Savings

There are two sources of savings for this EEM:

1. Minimize pressure - the more energy the blowers use to deliver air. By reducing the pressure the blowers use less energy.
2. Minimize the airflow – we know that at times some of the basins are provided with excess air, by providing automatic control of the valves serving the basins at times there will be less airflow delivered.

The air valves do not modulate automatically to maintain DO setpoints. The blowers are currently operated with a fixed pressure setpoint that is manually adjusted by operators several times a day, often resulting in more oxygen being delivered overnight and on weekends than is needed. This provides frequent overshoot of the DO setpoints, and results in excess electric energy used by the blowers. The controls will either be repaired or reprogrammed, or new controls will be installed as needed and commissioned to fully automate the amount of oxygen delivered to each zone using "most open valve" control strategy, so that it maintains proper setpoints and does not deliver more air than needed. In addition, the blower pressure setpoint will be automatically adjusted based upon actual plant demand, to minimize the pressure whenever possible. Less air will be delivered, and the air that is delivered will be at a lower pressure, resulting in electrical energy savings by minimizing the amount of work that the blowers perform.

2.3.2 EEM 3 – Specific Equipment Recommendations

- Leave the (4) existing VFDs in place (mounted in the Electrical Room)
- Leave the (4) existing blowers and their individual controllers in place (mounted on the blowers)
- Leave the Blower Master Controller in place (mounted in the Electrical Room), and replace failed equipment as necessary
- Leave the Rotork Valve Controller in place (mounted in the Electrical Room) and replace failed equipment as necessary
- Troubleshoot the (9) existing valves to be sure they are responding to the automatic control signals properly
- Troubleshoot and reprogram as needed the Rotork Valve controller so that each valve automatically modulates to maintain the dissolved oxygen pressure setpoint for that individual tank.
- Troubleshoot and reprogram as needed the Blower Master Controller so that the system pressure setpoint automatically resets downward when all the valves are less than 80% open, and it automatically resets upward when one of the valves is more than 90% open.
- Troubleshoot the oxygen flow meters and the SCADA total plant oxygen flow calculation so that they are within 10%.

2.3.3 EEM 3 – Setpoints and Algorithms Recommended to Achieve Energy Performance

- Target an initial startup blower pressure pressure of 10 psi. Include an automatic reset strategy that polls the position of the air valves, and automatically lowers the pressure setpoint by 0.1 psi if all valves are < 80% open for five minutes, and automatically increases the setpoint by 0.1 psi if one of the valves is > 90% open for five minutes. If they all remain < 80% after five minutes operating under the reduced pressure, then lower the pressure by another 0.1 psi. If one of the valves reaches 90% open then increase the pressure setpoint by 0.1 psi and repeat.

- Ensure that the DO setpoints are being maintained by reviewing SCADA trendlogs.
- Ensure that the Blower pressure setpoint is being reset by reviewing SCADA trendlogs
- Analyze how quickly the plant reacts to changes in DO levels, and verify that the DO levels never fall below 1.0 ppm threshold. Adjust control strategy as necessary to achieve this.

3 ENERGY EFFICIENCY MEASURE COSTS

Table 3: Summary of EEM 1 Costs

EEM 1: Optimize UV System Controls			
Item	**Description**	**Bidder**	**Total**
1	Controls Equipment	Wm Reilly Co	$61,300
2	Installation	Wm Reilly Co	$3,300
3	Programming / Startup / Commissioning	Wm Reilly Co	$8,500
4	New Control Boards	estimate	$35,000
5	SCADA Integration	OCD Automation	$8,800
Sub-Total			**$116,900**
Sales Tax		0.0%	$0
Contingency		5.0%	$5,845
Total Cost Eligible for Incentives			**$122,745**

Table 4: Summary of EEM 2 Costs

EEM 2: Install New UV System and Optimize UV System Controls			
Item	**Description**	**Bidder**	**Total**
1	UV Equipment	Wm Reilly Co	$225,000
2	Installation	Wm Reilly Co	$29,374
3	Programming / Startup / Commissioning	Wm Reilly Co	$0
4	SCADA Integration	estimate	$8,800
Sub-Total			**$263,174**
Sales Tax		0.0%	$0
Contingency		5.0%	$13,159
Total Cost Eligible for Incentives			**$276,333**

Table 5: Summary of EEM 3 Costs

EEM 3: Optimize Blower System Controls			
Item	**Description**	**Bidder**	**Total**
1	Equipment	Control Engineers	$50,807
2	Installation	Control Engineers	
3	Programming / Startup / Commissioning	Control Engineers	
4	SCADA Integration	Control Engineers	
Sub-Total			**$50,807**
Sales Tax		0.0%	$0
Contingency		5.0%	$2,540
Total Cost Eligible for Incentives			**$53,347**

4 BASELINE AND ANALYSIS OVERVIEW

4.1 Baseline Description

The City of Camas, WA treats municipal wastewater for approximately 20,000 people and businesses. Biological treatment of the wastewater requires adding dissolved oxygen with an aeration system, and final disinfection is achieved by applying ultraviolet (UV) light to the water. Both of these treatment processes have been evaluated for energy savings opportunities in this report.

The amount of wastewater being treated at any one time varies significantly throughout the year, and because of this variation there is an opportunity to save energy by refining the operation of the treatment processes. The variation in system flow is described here, followed by descriptions of the UV and aeration systems.

System Flow Variations:
The plant is designed to treat 10 million gallons per day of wastewater (10 MGD). The actual amount of wastewater that the plant treats varies from day to day, and from hour to hour. We have analyzed the historical amounts of wastewater treated for several years, and the following is a representation of the average daily flows for three and a half years:

Range of Water Flows (MGD)	Days Occurring from Jan 2011 - June 2014	
9-10	0	0%
8-9	0	0%
7-8	2	0%
6-7	8	1%
5-6	11	1%
4-5	39	3%
3-4	166	13%
2-3	971	76%
1-2	80	6%
0-1	0	0%

Thus the plant clearly is usually operating at flows well below the peak design. The table above shows the average daily flows, and even within the course of one day the flow varies. Flow typically starts to increase in the mornings as people wake up and start their day and as businesses begin production. Flows typically drop off in the evenings, overnight, and on weekends. Peak flows are experienced during rainfall periods.

UV System:

The final treatment prior to leaving the plant is to apply ultraviolet light to the waterstream. This is accomplished in the UV building. A channel of water passes under the floor, and UV lamps are placed directly in the water so the ultraviolet light is within a few inches of the water.

There are (4) arrays of UV lamps (visible in the picture), and each array is supplied power from a single disconnect in the motor control center. We recorded the power draw of each array for ten days at the motor control center, and we observed that all four banks are operating at full power 24 hours per day.

Each array has (12) banks of underwater lamps, and there is a single power cord that provides power for the single bank of lamps.

Each bank contains (8) lamps, and the lamps are rated for a nominal 87.5 watts each.

Existing UV System Baseline

# of Arrays	4
# of Banks/Array	12
# of Lamps/Bank	8
Total # of Lamps	384
# of Lamps/Array	96
Nominal Watts/Lamp	87.5
Nominal Watts/Array	8,400
Nominal Watts for ALL LAMPS	33,600
Average Measured Watts for ALL LAMPS	32,085

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Aeration System:
The facility has four centrifugal blowers housed in the Blower Building that provide air at approximately 10 psi, primarily to the three aeration basins. There is also small amount of air (< 10% overall airflow) delivered to the septic receiving station. Air can also be sent to the Head Cell Selectors, but they have been manually closed and are expected to remain in that position for the foreseeable future.

The blowers were each designed to deliver 1,400 scfm at 9.5 psi. According to the computer readouts, the airflow delivered ranges from 750 – 1,400 scfm at pressures that range from 9.7 – 10.2 psi.

Air delivered to the septic receiving tank should vary based on the level of water in the tank. During our visit the setpoint was 55 scfm, and 134 scfm was being measured by the flowmeter.

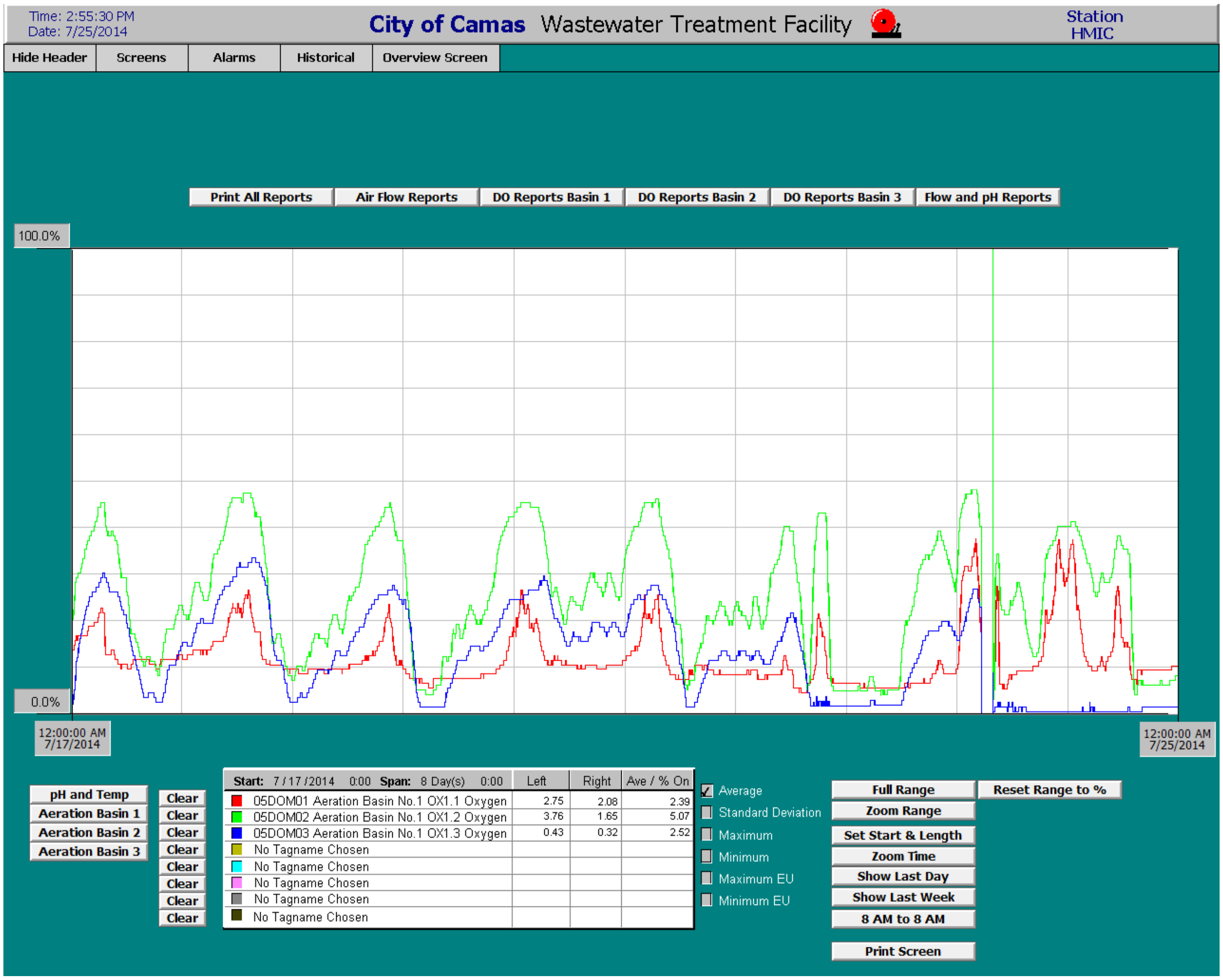
Air delivered to the Head Cell Selectors supply coarse bubble diffusers used to mix the water. The air feeding these zones has been manually closed for at least a year, as the operator is trying to minimize the amount of air in the water at this location, to promote anaerobic (without oxygen) treatment.

Air delivered to the three aeration basins supplies fine bubble diffusers that are located in three zones of each basin, for a total of nine zones. The first two basins are designed to operate with a DO setpoint of 2.0 ppm, to promote aerobic treatment. The third basin is designed to operate with a DO setpoint of 0.5 ppm, to allow aerobic treatment while minimizing the amount of oxygen in this stage, because some of the water from this stage is recirculated back to the head cell selectors, where they are trying to eliminate oxygen.

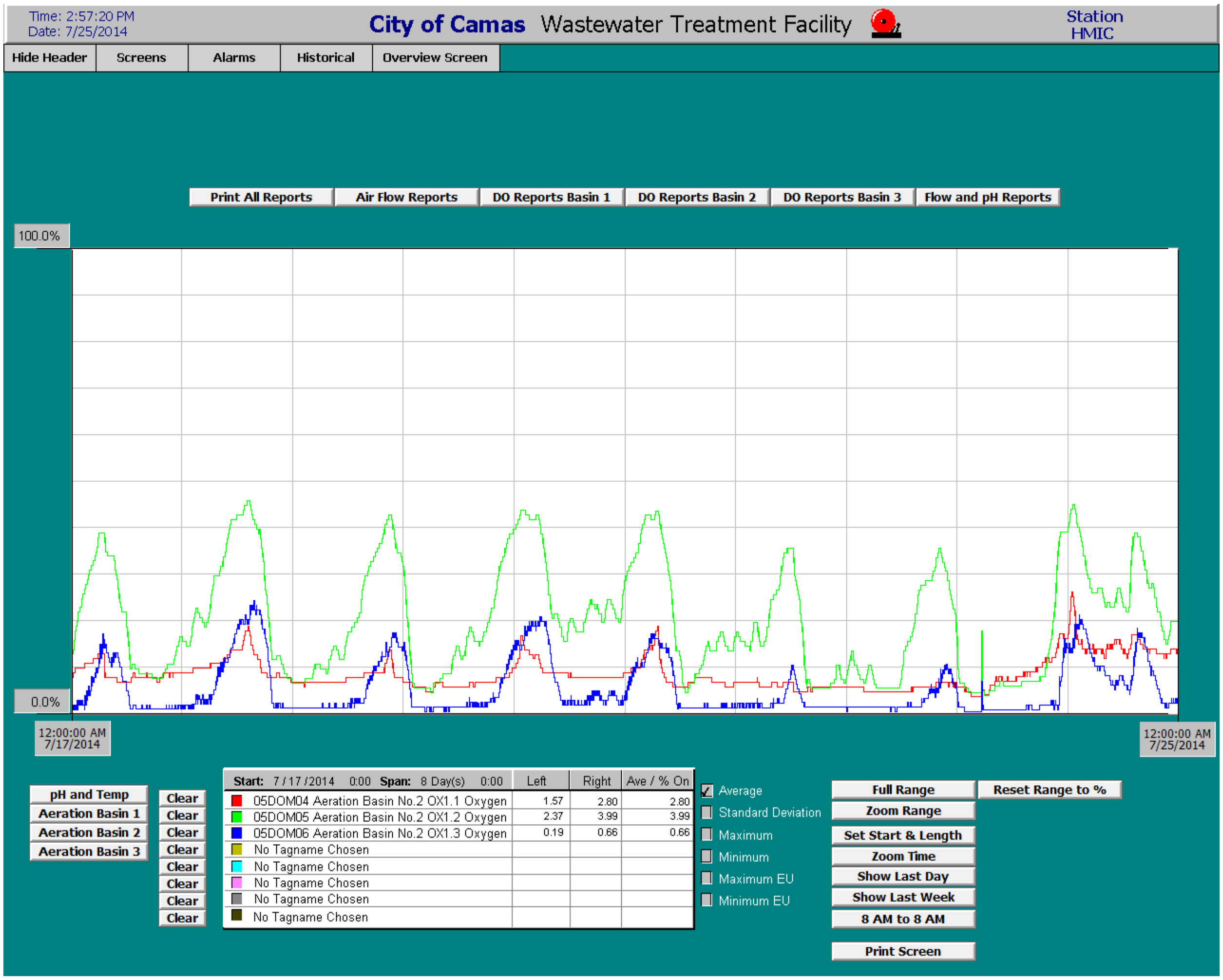
Each of these nine zones has one DO sensor, one airflow meter, and one automatic air valve that was designed to automatically adjust as needed to maintain the proper DO setpoint. These valves do not work automatically, and the valves have been manually positioned so that the system provides sufficient air at peak plant loads. This results in more air being provided than is necessary most of the time, especially overnight and on weekends when the plant loading is lighter.

We have reviewed trends from the SCADA system that show the DO levels being recorded in each zone of both basins, and it is clear that the DO setpoints are often exceeded.

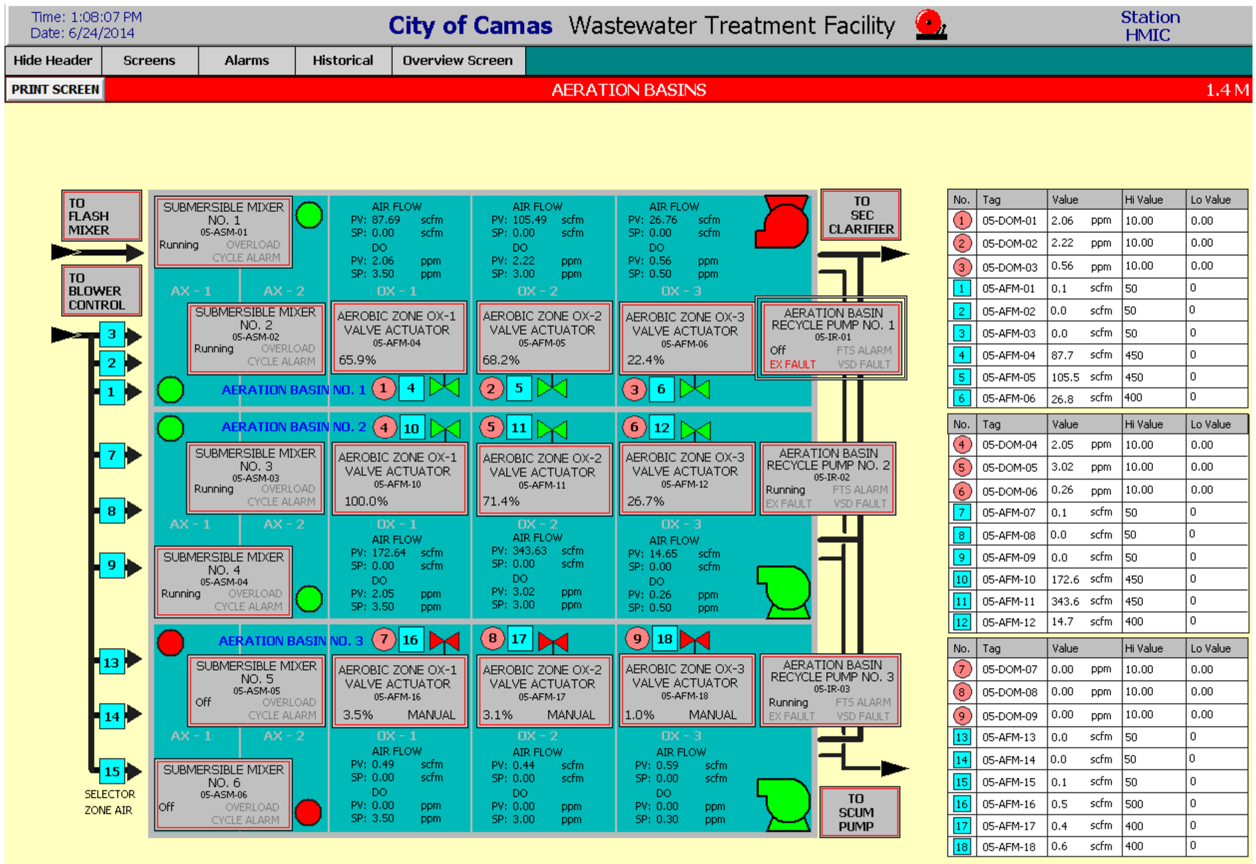
The trend below shows ten days of actual DO levels in all three zones of Aeration Basin 1. Over this time, the average DO levels in oxic zone 1 were 2.39 ppm, zone 2 was 5.07 ppm, and zone 3 was 2.52. So while there were times when all the zones had too little oxygen in them, on average over these ten days they all had more oxygen supplied to them than necessary, resulting in wasted electricity.



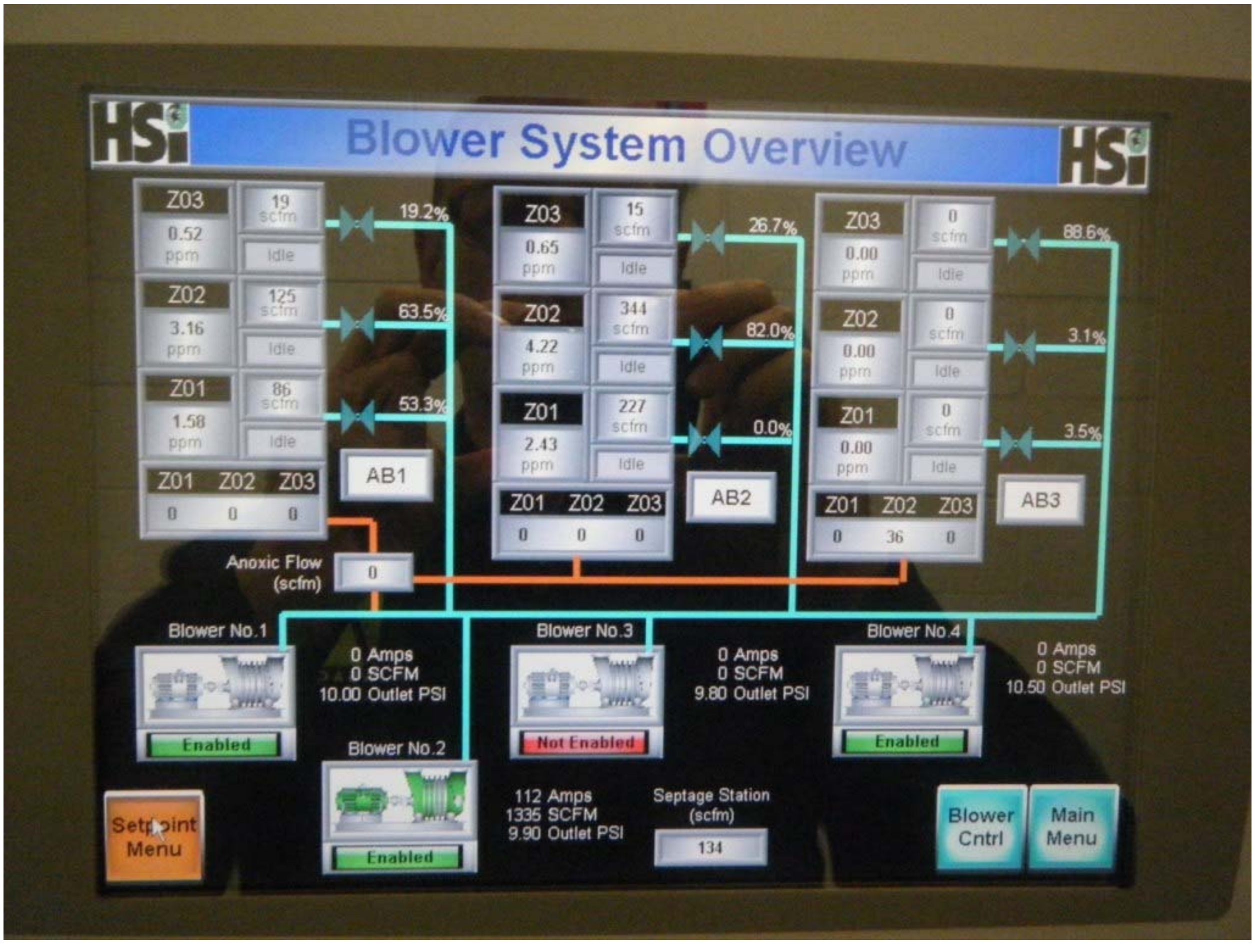
The trend below shows ten days of actual DO levels in all three zones of Aeration Basin 1. Over this time, the average DO levels in oxic zone 1 were 2.80 ppm, zone 2 was 3.99 ppm, and zone 3 was 0.68. So while there were times when all the zones had too little oxygen in them, on average over these ten days they all had more oxygen supplied to them than necessary, resulting in wasted electricity.



Here is a screen shot from the SCADA system showing the nine valves, setpoints and actual DO levels. Three of the valves are in red (16, 17 & 18) because they have been closed and that basin is not in use, nor is it expected to be used in the foreseeable future.



There is a Blower Master Control PLC that communicates with the Blower Building Level PLC, the individual Blower PLCs, and the Pacscan/Rotork controller.


HSi
Blower System Overview
HSi
Z03
0.52
ppm
19
scfm
Idle
19.2%
Z02
3.16
ppm
125
scfm
Idle
63.5%
Z01
1.58
ppm
86
scfm
Idle
53.3%
Z01 Z02 Z03
0 0 0
AB1
Z03
0.65
ppm
15
scfm
Idle
26.7%
Z02
4.22
ppm
344
scfm
Idle
82.0%
Z01
2.43
ppm
227
scfm
Idle
0.0%
Z01 Z02 Z03
0 0 0
AB2
Z03
0.00
ppm
0
scfm
Idle
88.6%
Z02
0.00
ppm
0
scfm
Idle
3.1%
Z01
0.00
ppm
0
scfm
Idle
3.5%
Z01 Z02 Z03
0 36 0
AB3
Anoxic Flow
(scfm)
0
Blower No.1
0 Amps
0 SCFM
10.00 Outlet PSI
Enabled
Blower No.3
0 Amps
0 SCFM
9.80 Outlet PSI
Not Enabled
Blower No.4
0 Amps
0 SCFM
10.50 Outlet PSI
Enabled
Blower No.2
112 Amps
1335 SCFM
9.90 Outlet PSI
Enabled
Septage Station
(scfm)
134
Setpoint
Menu
Blower
Cntrl
Main
Menu

4.2 Overview of Technical Approach

Custom spreadsheets were used to calculate the existing energy use, and proposed energy use for the measures evaluated in this report. After the existing energy use was calculated, it was compared to the actual metered energy use of the facility to be sure that the existing energy use is reasonable. The results of these spreadsheets are included in the appendix of this report.

4.2.1 Data Monitoring Results

Three and one half years of operational logs, 1/1/2011 – 6/30/14, was obtained for the overall plant from the on-site supervisor. Data was provided as average daily values. The following data was obtained from the on-site supervisor:

1. Plant Flow (MGD)
2. BOD5 (mg/L)
3. BOD5 (lb)
4. Suspended Solids (mg/L)
5. TSS (lb)
6. Ammonia (mg/L)
7. Ammonia (lb)

From the data above, we analyzed and determined an annual average daily flow profile as follows:

Range of Water Flows (MGD)	Days Occurring from Jan 2011 - June 2014	
9-10	0	0%
8-9	0	0%
7-8	2	0%
6-7	8	1%
5-6	11	1%
4-5	39	3%
3-4	166	13%
2-3	971	76%
1-2	80	6%
0-1	0	0%

Spot (instantaneous) power (kW, volts, amps, power factor) measurements were taken on the operating blower while we adjusted the operating pressure across the range of pressures that the systems operate under throughout the year. Three different readings were taken, at 9.7 psi, 10.0 psi, and 10.2 psi. We interpolated linearly between these pressure readings to assume power at 9.8 psi, 9.9 psi, and 10.1 psi.

Current (amp) measurements were also taken on the four banks of UV lamps, and on the four blowers for ten days (7/15/14 – 7/25/14). Only one blower operated at a time, averaging 75 kW, and we are informed this is typical. Using the volts and power factor averages from our spot measurements, the one blower operating at a time averaged 75 kW. The current draw is seen to take sharp drops and spikes, and this correlates to times when the operator manually changed the pressure setpoints.

All four UV banks operated all the time, averaging 32 kW, and we are informed this is typical.

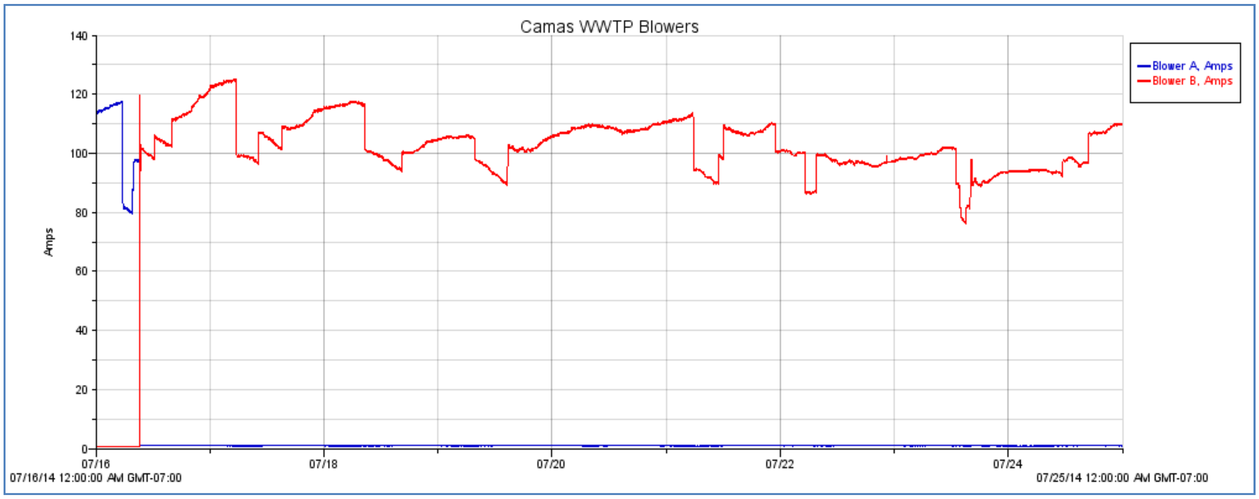


Figure 1: Blower Current

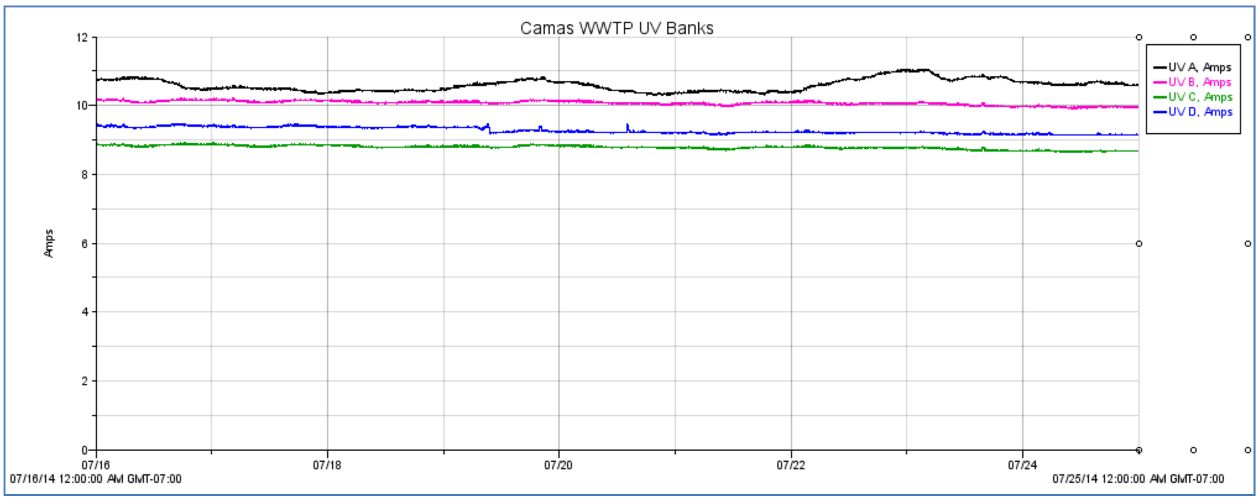


Figure 2: UV Current

4.2.2 Load Profiles

A daily load profile of the UV system was developed to model the proposed UV energy use. The load is based on the daily average flow rates. The existing UV energy use is constant 24 hours per day all year.

An hourly load profile was developed to model the existing baseline and proposed blower energy use. For the existing profile we plotted the measured kW at five different pressures, and we applied a % use load for each pressure so that the average annual kW matched the average kW recorded during nine days in July 2014. For the proposed profile we assumed that for all the hours operating at a given pressure, only a small percentage of hours are needed at this pressure, and most of the time the needs can be satisfied at a lower pressure. We were unable to use manufacturer curves to determine annual airflow delivered, nor were historical data available to us to use any other means to extrapolate the annual energy use. The annual utility use if a fairly flat profile, so it seems safe to assume the blower operates at this average condition all year.

4.2.3 Baseline Analysis

Both the UV and blower power were modeled assuming the average kW recorded in July is the same as the average kW used all year, 24 hours per day.

The blower analysis correlated this to pressure and power plots that were recorded on site, using measured kW values for three different operating pressures (9.7, 10.0 and 10.2 psi) and linearly interpolating points between. These values were used because the operators inform us that these are the maximum and minimum (and near the middle) manual setpoints they typically use to adjust airflow to the aeration basins. There is no historical SCADA data that the owner has been able to provide to use any other assumptions. We assumed a corresponding % use per year profiles that was applied to these seven pressure/power points and modified them until the annual blower power average matched the average recorded power in July.

Final combined baseline energy use was determined to be 936,781 kWh/yr.

> Note: It is anticipated that the blower energy use does vary from season to season, depending on both the weather and the loads imparted on the plant. The loads are primarily a function of flow, BODs, and ammonia. Because the power will likely vary throughout the year, the **baseline energy use for the blower for the utility incentive program may be adjusted prior to the EEM being installed**. This can be accomplished by measuring the blower power flow for one additional week in the winter, and two additional weeks in the spring or fall, and then averaging the four weeks of blower power and assuming that on an annual average the plant operates at the average power recorded during these four weeks. An alternate method to adjust the baseline energy use for the utility incentive program is to measure the blower power for four consecutive weeks, while simultaneously having the SCADA record hourly values of the flow, ammonia and BODs both entering and leaving the plant. The blower power can then be described as a function of flow, ammonia and BODs. This function can then be applied to the historical flows to calculate the annual baseline energy use for the blowers. In order for this method to be used, the SCADA system must be capable of recording the trends at precise intervals and downloading this data for utility review. This does not currently seem to be in place at this point in time.

4.2.4 EEM 1 – Optimize UV System Controls Analysis

The UV was modeled with controls that vary the power based on the wastewater flow. The manufacturer of the UV system (Trojan) provided the power required at various flows, and we assumed flows over the last 3 ½ years are typical.

4.2.5 EEM 2 – Install New UV System and Optimize UV System Controls Analysis

The new UV was modeled with reduced power demands, and controls that vary the power based on the wastewater flow. The manufacturer of the new UV system (Trojan) provided the power required at various flows, and we assumed flows over the last 3 ½ years are typical.

4.2.6 EEM 3 – Optimize Aeration System Controls Analysis

The aeration system was modeled with reduced pressure requirements resulting from providing only the amount of air needed, and a control strategy that automatically lowers and raises the pressure setpoint as needed, based on actual demand.

4.3 Key Assumptions

4.3.1 Key Assumptions for Baseline Analysis

The following key assumptions were made in the baseline analysis:

1. UV Power draw is constant all year.
2. Annual Average Blower Power is equal to the average blower power recorded over ten days in July, 2014.

4.3.2 Key Assumptions for EEM 1 – Optimize UV System Controls Analysis

The following key assumptions were made in the EEM analysis:

- The proposed power required by the UV matches the power requirements that the manufacturer (Trojan) stated.
- Adequate decontamination levels will be achieved by using the proposed UV power requirements from the manufacturer (Trojan)
- The flows through the plant will remain the same as the last 3 ½ years

4.3.3 Key Assumptions for EEM 2 Install New UV System and Optimize UV System Controls Analysis

The following key assumptions were made in the EEM analysis:

- The proposed power required by the new UV matches the power requirements that the manufacturer (Trojan) stated.
- Adequate decontamination levels will be achieved by using the proposed UV power requirements from the manufacturer (Trojan)
- The flows through the plant will remain the same as the last 3 ½ years

4.3.4 Key Assumptions for EEM 3 Optimize Aeration System Controls Analysis

The following key assumptions were made in the EEM analysis:

- One blower operates to satisfy the demand all year.
- At pressures of 9.7, 10.0 and 10.2 psi the power recorded on site are typical throughout the year for the same operating pressure.
- Between the three pressures above the power will change linearly as the pressure changes.
- At operating pressures below 9.7 psi the power of the blower will only be reduced by 1 kW per psi.

- The airflow requirements of the plant will not increase in the future (this implies that the overall flow, BODs and ammonia levels do not increase).

- The following assumptions are made regarding the proposed operating pressures:

3%	of the airflow at a given existing pressure is actually required to be at a pressure that high			
5%	of the airflow at a given existing pressure is actually required at	0.1	psi lower than existing	
7%	of the airflow at a given existing pressure is actually required at	0.2	psi lower than existing	
9%	of the airflow at a given existing pressure is actually required at	0.3	psi lower than existing	
11%	of the airflow at a given existing pressure is actually required at	0.4	psi lower than existing	
13%	of the airflow at a given existing pressure is actually required at	0.5	psi lower than existing	
15%	of the airflow at a given existing pressure is actually required at	0.6	psi lower than existing	
13%	of the airflow at a given existing pressure is actually required at	0.7	psi lower than existing	
11%	of the airflow at a given existing pressure is actually required at	0.8	psi lower than existing	
9%	of the airflow at a given existing pressure is actually required at	0.9	psi lower than existing	
4%	of the airflow at a given existing pressure is actually required at	1.0	psi lower than existing	

  For instance, when the blower currently delivers air at 10.2 psi, only 3% of the time does the air need to be at this high of a pressure, 5% of the time it can be delivered at 10.1 psi, 7% of the time it can be delivered at 10.0 psi, 9% of the time it can be delivered at 9.9 psi, etc. These assumptions lead to the anticipated plant typically operating at 9.5 psi +/- 0.2 psi for 60% of the year.

- The overall energy savings calculated for this EEM is 41% of the existing blower energy. This is a relatively high percentage energy savings to expect and there are several factors that lead us to conclude that the predicted energy savings are reasonable. The system is operating with manual controls – and these must be set to meet the worst case conditions – resulting in delivering too much air. The system is also operating with fixed pressure, which means it is always delivering air at a higher pressure than needed. The system is essentially operating manually to clean the water, and it is doing a good job of that, but it is doing it at the expense of energy use. Just as we saw in the UV system running out of control – where we are predicting over 75% energy savings for that system.

4.4 Summary of Results

Table 6: Modeling Summary - Recommended Package

EEM	Description	UV System Energy (kWh/yr)	Blower System Energy (kWh/yr)	Total System Energy (kWh/yr)	Energy Savings (kWh/yr)	Energy Savings (%)
	Baseline (UV & Blowers)	281,064	655,716	936,781		
1	Optimize UV System Controls	77,041	655,716	732,758	204,023	21.8%
3	Optimize Aeration System Controls	77,041	383,865	460,907	271,851	29.0%
TOTALS				**936,781**	**475,874**	**50.8%**

5 COMPLETION REPORT PLAN

After EEMs have been installed and are online and operating in a steady state manner, it is necessary to provide a completion report. Project incentives are paid upon utility and BPA approval of the completion report. In general, the completion report consists of the following:

1. Measurement and verification (M&V) of installed EEMs
2. Summary of commissioning of installed EEMs
3. Summary of actual projects costs of installed EEMs

The completion report will document the actual energy savings achieved by each EEM and actual implementation cost. The estimated energy savings and implementation costs provided in this project assessment may differ from what is ultimately determined in the completion report.

In most cases, the TSP consultant that provided this project assessment report will be utilized for the completion report. Funding of the TSP consultant for the completion report is available from BPA upon BPA approval. BPA may require the City of Camas to share a portion of the TSP consultant cost.

5.1 Measurement and Verification Plan

M&V will be provided for each installed EEM. The equipment installed for each EEM will be verified and documented. To verify EEM performance, the following data will be obtained:

1. UV current draw (amperes) for all four banks
2. Blower current draw for all four blowers
3. Blower discharge pressure
4. Blower total airflow
5. Plant Daily average influent and effluent flow (MGD) and BOD (lb), TSS (lb) Ammonia (lb)

The facility SCADA system and/or portable data loggers can be utilized to obtain the data.

For EEM 1 Four weeks of data will likely be necessary to verify EEM performance. At the same time the UV current is measured, the SCADA should be recording the flowrate. The measured current can then be correlated to actual flowrates, and then the historical annual flowrates can be used to project future annual energy use based upon the four weeks of recorded data, correlated with historical annual flowrates.

For EEM 2, Four weeks of data will likely be necessary to verify EEM performance. We suggest one week during the summer, one week during the winter, and two weeks in either the Fall or Spring – during times which represent typical conditions for the plant. The average power recorded during these four weeks would then be used to calculate the annual energy used by the blowers.

> Note: As an alternate to measuring the power of the blowers for one week in the summer, one week in the winter, and two weeks in the fall or spring – instead four consecutive weeks could be recorded at the same time that the plant SCADA records flow, BODs and ammonia loads on the plant in at least hourly values. This four week of data could then be used to correlate the after-upgrade blower power against plant flow, ammonia and BODs – and then a model could be used to calculate the annual energy that this blower would use based on historical flows, BODs and ammonia loads and the after-upgrade measured power.

The baseline developed in this PAR will be revised based on recording the power of the blowers measured over four weeks – one week in the summer, one in the winter, and two weeks in the fall or spring. The average power recorded during these four weeks will be used to calculate the revised baseline energy used by the existing blowers prior to this upgrade.

If there are changes to the way the plant operates it may necessitate further changes to the baseline energy use of these systems. If there is a significant change in the amount of and/or the quality of influent received at this facility it may necessitate a change to the baseline energy use. If there is a significant change in the amount of and/or the quality of effluent sent out from this facility it may necessitate a change to the baseline energy use.

5.2 Instrumentation Required

Portable data loggers and SCADA will be used to provide M&V and commissioning of the EEMs. The existing facility SCADA system will be utilized to obtain the necessary data for the airflow and discharge pressure. Daily logs of plant flows, TSS, BOD and ammonia will be used to track changes to the plant operation. Portable loggers will be used to measure the current draw of the UV and blower systems.

5.3 Personnel Required

Plant personnel will be asked to provide the following as part of the preparation of the completion report:

1. A tour of the installed EEMs
2. Forward periodic downloads of SCADA system hourly data by email to completion report agent
3. Forward daily logs of flows and BODs, TSS, ammonia to completion report agent
4. Documentation of EEMs implementation costs

5.4 Logistical Requirements

Multiple site visits are anticipated as part of the completion report process:

- Prior to upgrade being installed – one trip to install portable loggers in the Fall, and one trip to retrieve them
- Prior to upgrade being installed – one trip to install portable loggers in the Winter, and one trip to retrieve them
- After the upgrade – one trip to install loggers and one trip to retrieve them – this may happen one time for four weeks consecutively – or it may happen in three different time periods – one in the summer, one in the winter, and one in the spring or fall.

6 APPENDIX 1 – ENERGY CALCULATIONS

Calculation of Savings for EEM 1 – Optimize UV System Controls

Energy Use Calculation with Existing UV 3000 System

Average MGD	Days / Year	Existing UV Power (kW)	Existing UV Energy (kWh)	Proposed UV Power (kW)	Proposed UV Energy (kWh)	UV Energy Savings (kWh)
9.5	0	32	0	25.2	0	0
8.5	0	32	0	25.2	0	0
7.5	1	32	440	16.8	230	210
6.5	2	32	1,761	16.8	922	839
5.5	3	32	2,421	16.8	1,268	1,153
4.5	11	32	8,584	16.8	4,495	4,089
3.5	47	32	36,536	8.4	9,565	26,971
2.5	278	32	213,715	8.4	55,951	157,763
1.5	23	32	17,608	8.4	4,610	12,998
0.5	0	32	0	8.4	0	0
TOTALS	365		**281,064**		77,041	**204,023**

Calculation of Savings for EEM 2 – Install New UV System and Optimize UV System Controls

Energy Use Calculation with New UV 3000PLUS System

Average MGD	Days / Year	Existing UV Power (kW)	Existing UV Energy (kWh)	Proposed UV Power (kW)	Proposed UV Energy (kWh)	UV Energy Savings (kWh)
9.5	0	32	0	16.8	0	0
8.5	0	32	0	15.1	0	0
7.5	1	32	440	14.3	196	244
6.5	2	32	1,761	12.6	691	1,069
5.5	3	32	2,421	12.6	951	1,470
4.5	11	32	8,584	10.1	2,702	5,882
3.5	47	32	36,536	8.8	10,044	26,493
2.5	278	32	213,715	7.1	47,559	166,156
1.5	23	32	17,608	6.3	3,457	14,150
0.5	0	32	0	6.3	0	0
TOTALS	365		**281,064**		65,600	**215,464**

Calculation of Savings for EEM 3 – Optimize Aeration System Controls

Existing Energy Use Calculation

Pressure (psi)	% of Time	Hours / Year	Existing Average Power (kW)	Existing Annual Energy (kWh)
10.2	60%	5,256	82	429,845
10.1	20%	1,752	73	127,267
10.0	9%	788	64	50,038
9.9	5%	438	56	24,488
9.8	4%	350	48	16,911
9.7	2%	176	41	7,168
9.6	0%	0		
9.5	0%	0		
9.4	0%	0		
9.3	0%	0		
9.2	0%	0		
9.1	0%	0		
9.0	0%	0		
8.9	0%	0		
TOTALS	100%	8,760	75	**655,716**

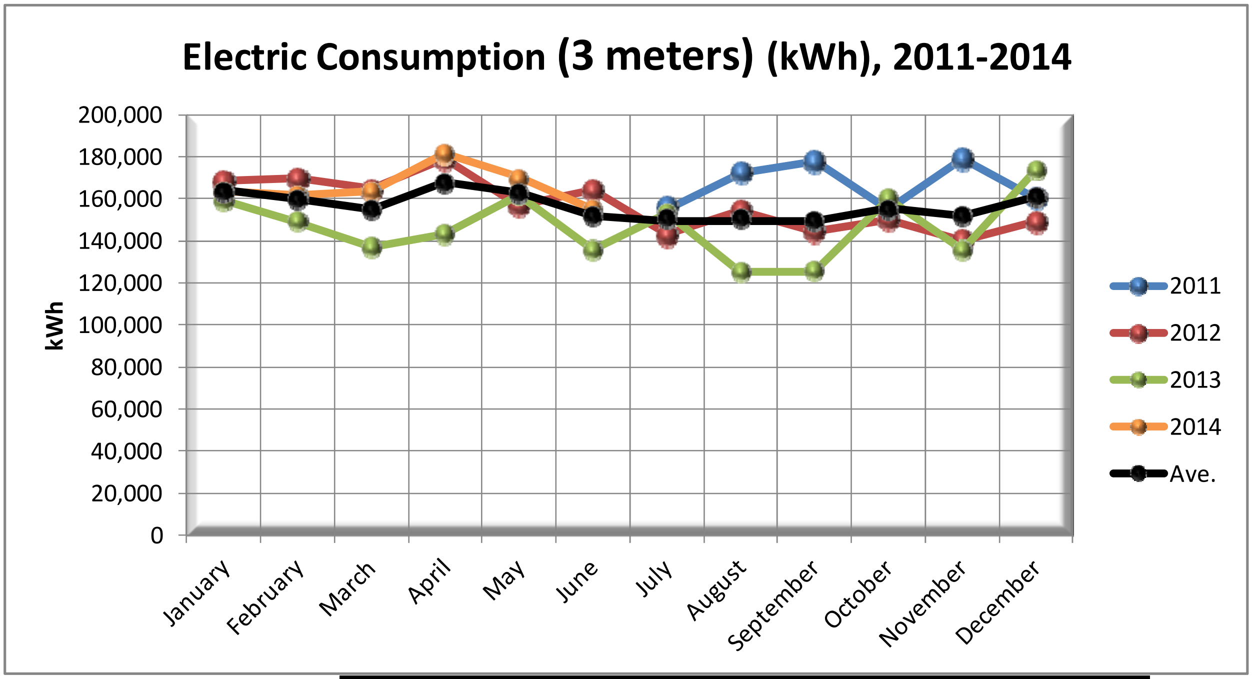
Proposed Energy Use Calculation

Pressure (psi)	% of Time	Hours / Year	Proposed Average Power (kW)	Proposed Annual Energy (kWh)	Prposed Energy Savings (kWh)
10.2	2%	158	82	12,895	416,950
10.1	4%	315	73	22,908	104,359
10.0	5%	479	64	30,427	19,611
9.9	7%	648	56	36,241	-11,753
9.8	9%	823	48	39,784	-22,873
9.7	11%	1,000	41	40,739	-33,572
9.6	13%	1,176	40	46,699	-46,699
9.5	13%	1,141	39	44,166	-44,166
9.4	12%	1,035	38	39,060	-39,060
9.3	10%	899	37	33,007	-33,007
9.2	7%	587	36	20,967	-20,967
9.1	3%	261	35	9,066	-9,066
9.0	2%	132	34	4,462	-4,462
8.9	1%	105	33	3,445	-3,445
TOTALS	100%	8,760	44	383,865	**271,851**

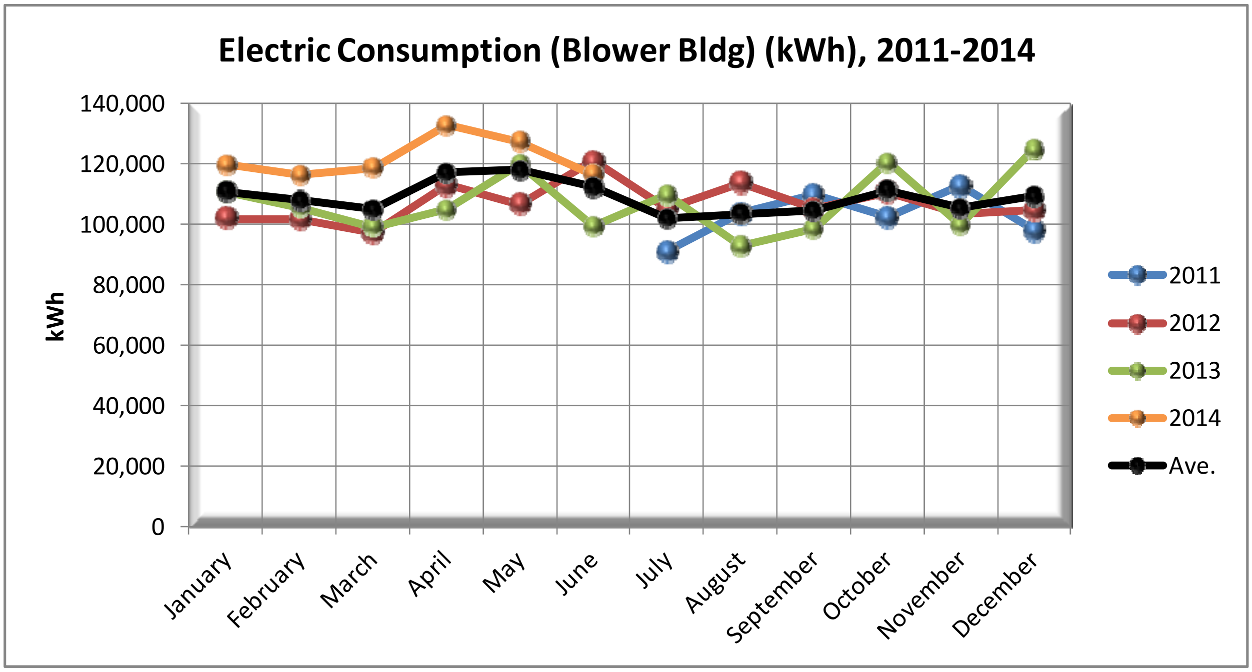
7 APPENDIX 2 – EXISTING UTILITY USE

This site has three electric meters. There is one meter that is attached to the UV building, and the UV energy use appears on this meter. There is one meter that is attached to the Blower building, and the Blower energy use appears on this meter. There is one other smaller meter in a storage shed building, and most of the load served by this meter has been moved to the UV meter over the last few years.

Overall the energy used at these meters is fairly constant over the course of a year, and is fairly consistent from year to year.



	Electric Usage (3 meters) (kWh)					
	2011	2012	2013	2014	Last 12 Mo.	Ave.
January		168,320	159,520	163,600	163,600	163,813
February		169,600	149,120	161,520	161,520	160,080
March		164,400	137,280	163,440	163,440	155,040
April		178,880	143,200	181,360	181,360	167,813
May		156,880	162,240	170,000	170,000	163,040
June		164,160	135,840	154,720	154,720	151,573
July	156,240	142,880	153,200		153,200	150,773
August	172,800	154,160	125,120		125,120	150,693
September	177,840	144,160	125,760		125,760	149,253
October	155,200	149,840	160,480		160,480	155,173
November	179,360	140,160	136,080		136,080	151,867
December	160,480	149,040	174,400		174,400	161,307
Total	**1,001,920**	**1,882,480**	**1,762,240**	**994,640**	**1,869,680**	**1,880,427**

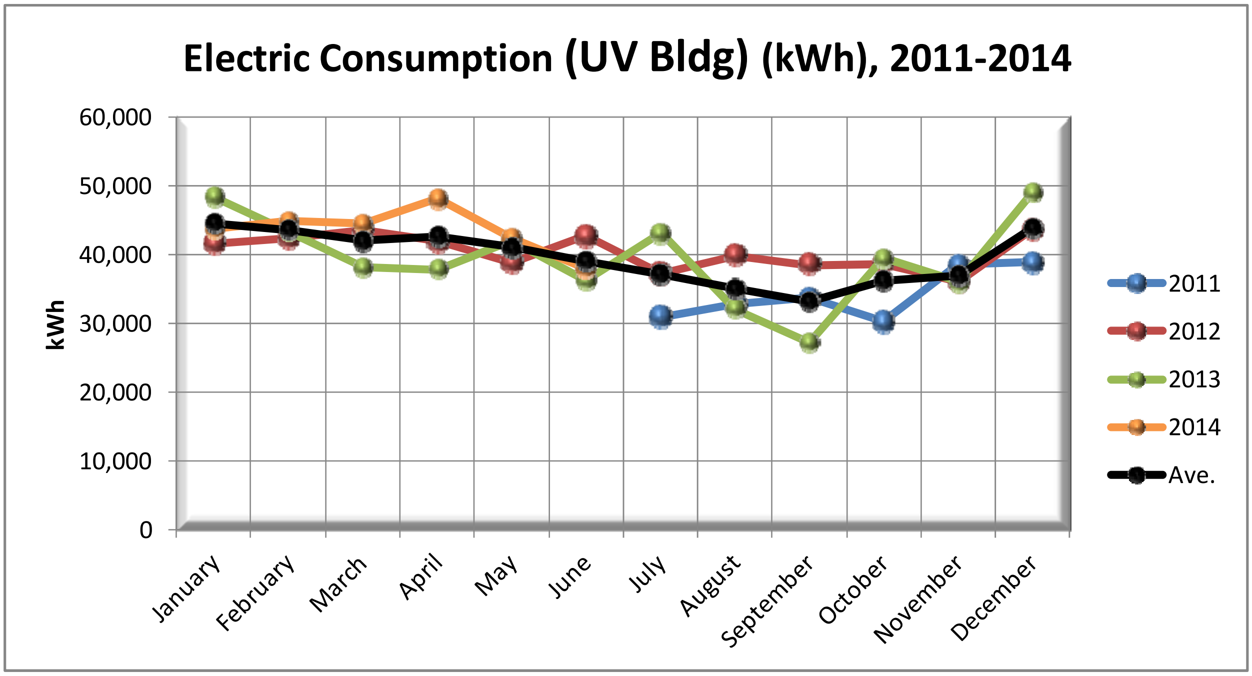


	Electric Usage (Blower Bldg meter) (kWh)					
	2011	2012	2013	2014	Last 12 Mo.	Ave.
January		102,240	110,880	119,760	119,760	110,960
February		102,000	105,600	116,400	116,400	108,000
March		97,440	99,120	118,800	118,800	105,120
April		113,280	105,120	132,960	132,960	117,120
May		107,040	120,000	127,440	127,440	118,160
June		121,200	99,360	116,640	116,640	112,400
July	90,960	105,360	109,920		109,920	102,080
August	103,680	114,000	92,880		92,880	103,520
September	109,680	105,360	98,400		98,400	104,480
October	102,240	110,880	120,720		120,720	111,280
November	112,800	103,920	99,840		99,840	105,520
December	97,920	105,120	125,040		125,040	109,360
Total	**617,280**	**1,287,840**	**1,286,880**	**732,000**	**1,378,800**	**1,308,000**

Note 1: The Blower Building meter accounts for 70% of the overall site energy use

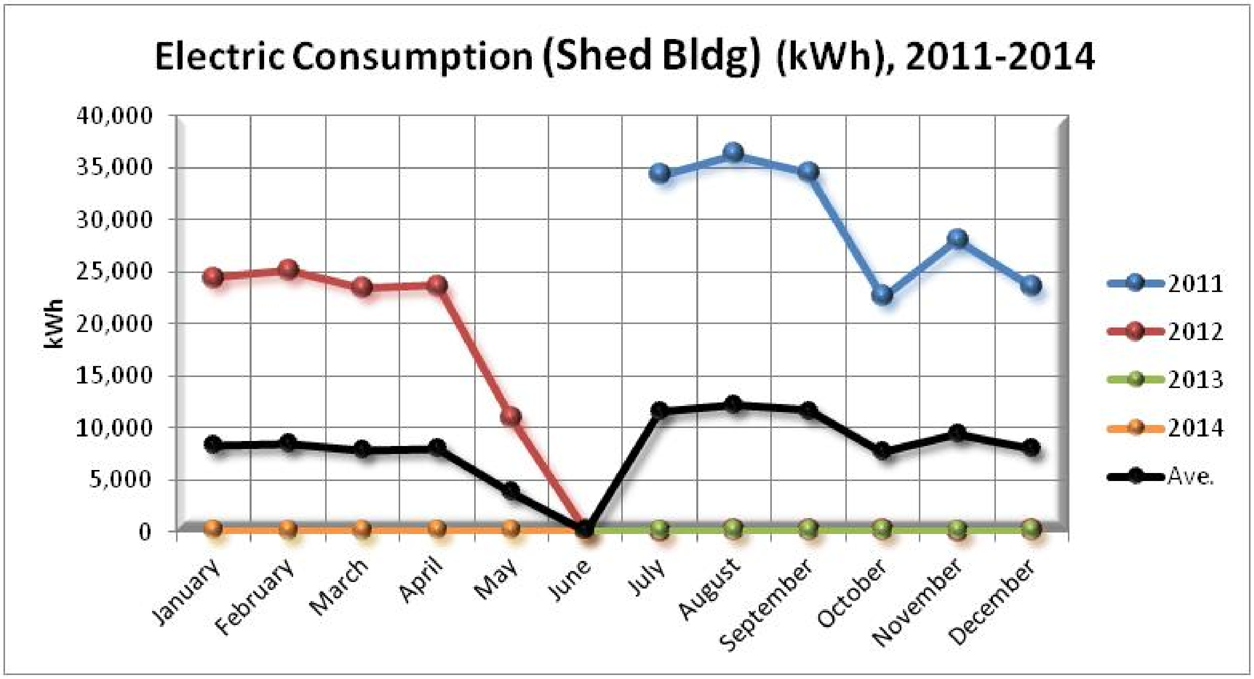
Note 2: The Blower equipment energy use accounts for 50% of the Blower Building metered energy use

Note 3: The Blower equipment energy use accounts for 35% of the overall site energy use



	Electric Usage (UV Bldg meter) (kWh)					
	2011	2012	2013	2014	Last 12 Mo.	Ave.
January		41,680	48,400	43,680	43,680	44,587
February		42,480	43,440	44,880	44,880	43,600
March		43,600	38,080	44,480	44,480	42,053
April		42,000	37,840	48,160	48,160	42,667
May		38,880	42,000	42,320	42,320	41,067
June		42,720	36,320	38,000	38,000	39,013
July	30,960	37,440	43,120		43,120	37,173
August	32,800	40,000	32,080		32,080	34,960
September	33,680	38,640	27,200		27,200	33,173
October	30,320	38,800	39,520		39,520	36,213
November	38,480	36,160	36,080		36,080	36,907
December	38,960	43,760	49,120		49,120	43,947
Total	**205,200**	**486,160**	**473,200**	**261,520**	**488,640**	**475,360**

Note 1: The UV Building meter accounts for 25% of the overall site energy use
Note 2: The UV equipment energy use accounts for 59% of the UV Building metered energy use
Note 3: The UV equipment energy use accounts for 15% of the overall site energy use



	Electric Usage (Shed Bldg meter) (kWh)					
	2011	**2012**	**2013**	**2014**	**Last 12 Mo.**	**Ave.**
January		24,400	240	160	160	8,267
February		25,120	80	240	240	8,480
March		23,360	80	160	160	7,867
April		23,600	240	240	240	8,027
May		10,960	240	240	240	3,813
June		240	160	80	80	160
July	34,320	80	160		160	11,520
August	36,320	160	160		160	12,213
September	34,480	160	160		160	11,600
October	22,640	160	240		240	7,680
November	28,080	80	160		160	9,440
December	23,600	160	240		240	8,000
Total	**179,440**	**108,480**	**2,160**	**1,120**	**2,240**	**97,067**

8 APPENDIX 3 – EXISTING PLANT USAGE

The owner has provided us with 3 ½ calendar years of plant usage history, detailing the quantity and quality of the wastewater that enters the plant to be treated. To calculate the proposed energy use, we have assumed that the future plant usage will remain relatively constant. If the quantity (or quality) of the wastewater entering the plant to be treated changes significantly in the future, then this will affect the future energy use. Likewise, if future regulations require changes in the quality of the treated effluent leaving the plant, this will also affect the future energy use.

2011	Plant Influent						
Date	Flow (MGD)	BOD (mg/l)	BOD (lbs)	Suspended Solids (mg/l)	TSS (lbs)	Ammonia (mg/L)	Ammonia (lbs)
AVG	2.5	108	2221	130	2733	44.2	893
MIN	1.9	32	1189	25	411	14.6	500
MAX	6.6	214	8454	472	17014	73.8	1441
TOTAL	918.1		464,106		568,418		184,899

2012	Plant Influent						
Date	Flow (MGD)	BOD (mg/l)	BOD (lbs)	Suspended Solids (mg/l)	TSS (lbs)	Ammonia (mg/L)	Ammonia (lbs)
AVG	2.748	100	2206	129	2842	39.4	874
MIN	1.928	36	813	2	40	0.3	7
MAX	7.534	237	4463	2426	51634	59.1	1614
TOTAL	1,003.1		458,879		591,179		180,993

2013	Plant Influent						
Date	Flow (MGD)	BOD (mg/l)	BOD (lbs)	Suspended Solids (mg/l)	TSS (lbs)	Ammonia (mg/L)	Ammonia (lbs)
AVG	2.416	112	2,229	138	2,706	39.8	790
MIN	1.867	45	1,024	38	1,004	10.1	356
MAX	7.093	347	7,903	602	11,015	60.7	1,426
TOTAL	881.8		465,801		565,577		163,516

2014	Plant Influent						
Date	Flow (MGD)	BOD (mg/l)	BOD (lbs)	Suspended Solids (mg/l)	TSS (lbs)	Ammonia (mg/L)	Ammonia (lbs)
AVG	**2.711**	**92**	**2026**	**93**	**2066**	**35.0**	**763**
MIN	**1.989**	**51**	**1265**	**35**	**834**	**10.3**	**260**
MAX	**5.115**	**217**	**4327**	**247**	**6922**	**93.1**	**1703**
TOTAL	**490.7**		**206,692**		**212,839**		**78,539**

Note: The table above for 2014 only covers ½ the year – through June 30, 2014

9 APPENDIX 4 – VENDOR QUOTES

Vendor Quote for EEM 1 – Optimize UV System Controls

TROJAN UV
WATER CONFIDENCE™

UV3000™ DISINFECTION SYSTEM UPGRADE

For

CITY OF CAMAS WWTP
1129 S. E. POLK STREET
CAMAS, WA 98607

ATTENTION: JIM DICKINSON

Date: July 24, 2014
Report No: RO_Project No_311103

NOTICE
This report is proprietary and may not be reproduced or distributed to parties not directly associated with the Camas, WA WWTP without the express written permission of Trojan Technologies.

TROJAN TECHNOLOGIES 3020 GORE ROAD, LONDON, ONTARIO, CANADA N5V 4T7 T 519 457 3400 F 519 457 3030 WWW.TROJANUV.COM

Page 1 of 5

Vendor Quote for EEM 1 – Optimize UV System Controls (continued)

TROJANUV
WATER CONFIDENCE

Upgrade Summary

The UV3000 system's SCC (system control center) was modified some time ago and can no longer be supported by Trojan Technologies. It is recommended that the site upgrades the SCC to a new platform and/or consider upgrading the UV3000 system to a newer UV disinfection technology.

The following factors have been considered/incorporated into the SCC upgrade recommendation:

- Utilize Trojan's standard AB Compact Logix PLC platform; this enables the new SCC to be utilized within an overall system upgrade to a UV3000+ in future
- Programming will be for the original UV3000 control philosophy and will incorporate the 4th added bank into the control architecture
- Any control or communication boards within the existing UV equipment are considered to be in good working order; any other items modified or removed during the previous SCC modifications have not been allowed for in the quoted scope of works

The recommended scope of work, equipment and services to upgrade the SCC are described on the following pages. Should you require any clarification or if you have any questions then please call or email.

Yours truly,

Original Signed by Mark Eyre

Mark Eyre
Municipal Service
Refurbishment & Optimization

TROJAN TECHNOLOGIES 3020 GORE ROAD, LONDON, ONTARIO, CANADA N5V 4T7 T 519 457 3400 F 519 457 3030 WWW.TROJANUV.COM

Vendor Quote for EEM 1 – Optimize UV System Controls (continued)

TROJAN UV
WATER CONFIDENCE™

System Control Center (SCC) Scope of Supply: Parts

A new System Control Center (SCC) shall be supplied to monitor & control the UV System and contains the main components as outlined in the table below. The price does not allow for site installation services. Site service is described separately.

QTY	DESCRIPTION	UNIT MODEL NUMBER / COMMENT
1	Processor: AB Compact Logix L35	1769-L35
1	Operator Interface: PanelView Plus 700 Color, 7 inch	2711P-T7C4D1
1	SCADA Communications Ethernet/IP	Built into PLC
1	Panel 30"H x 30"W x 12"D estimated (new cabinet required).	Panel Construction: 304 SS; wall mounted, outdoor location; sunshade, NEMA 4X enclosure rating; service outlet; panel heater, lifting lugs. Electrical: 120VAC, 60 Hz. Drawing approval process confirms site fit/location.
1	Digital Inputs/Outputs	16/16 available
1	Analog Inputs/Outputs	4/0 available
1	PLC Programming & testing	Downloaded and configured to original site control philosophy
	Total SCC Panel Price US$	**61,300.00**

System Control Center (SCC) Scope of Supply: Service

The following site service will be required to complete the inspection, commissioning and startup of the new SCC.

Description	Certified Technician	Total Price (US$)
Travel Days, estimated, invoice @ actual	2-Service	2,920.00
Site Days Required, estimated, invoice @ actual	3-Service	4,380.00
Number of Technicians	1-Service	n/a
Daily Rate (US$)	1,460	n/a
Airfare, estimated, invoice @ actual (US$)	1,200 ea	1,200.00
Total Service Price US$		**8,500.00**

Note: Travel is based on utilizing Trojan Technician @ $1,460 day rate; utilizing certified technician from local Trojan representative could reduce travel (days & flight/car) to nil; we would utilize most cost effective service technician as per overall order and customers' preference.

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Page 3 of 5

Vendor Quote for EEM 1 – Optimize UV System Controls (continued)

Site Responsibility:

Site will be responsible for approving (or providing approval as noted) the submittal drawing(s) and SCADA address list (if applicable). Site will be responsible for removing the old SCC panel & installing & mounting the new SCC panel as indicated on the final drawing.

Site will be responsible for the transfer of (or new supply of) the following connections from the old panel to the new panel:

1. One (1) 120 volt, 60 Hz, 1 Phase, 2 wire (plus ground), power supply
2. One (1) ground link, 14 gauge minimum type TWH stranded, daisy chained to the PDC's
3. Serial communication links from the PDC's (daisy chained)
4. One (1) analog input from the plant flow meter
5. One (1) digital input from the Low Level Sensor & seven (7) digital outputs (banks status, alarms, heater)
6. One communication cable from plant SCADA (if required)
7. Any communications wiring that is too short for direct connection to the new SCC panel connections will have to be replaced as "splicing" is not allowed

Note that panel installation and power connections are required to be completed prior to Certified Service Technician arrival on site. Failure for site to be ready could result in technician needing to return at additional cost.

Site will be responsible for making operators available for training on the new SCC control panel.

Trojan Responsibility:

Trojan will be responsible for providing submittal drawing(s) for site approval (or approval as noted).

Certified Service/Control Technician is responsible for:

1. Verifying correct installation (power, mounting, configuration, communications, etc) of the SCC;
2. Verifying correct SCC/PDC operation;
3. Providing operator training.

Documentation:

One electronic copy of the following documentation will be supplied by Trojan:

1. Submittal drawings for approval; final (as approved) submittal drawings
2. Appropriate sections of the O&M Manuals updated

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TROJAN UV
WATER CONFIDENCE™

<u>Terms & Conditions:</u>

Trojan Technologies Terms and Conditions of Sale and Service apply and are available upon request.

Shipment terms are ExWorks (ExW) London Ontario Canada. Partial shipments allowed.

Freight costs are available on request and freight will be added to the invoice.

Payment terms are NET 30 days.

Quote validity is 30 days.

Delivery is 10 -12 weeks to be confirmed at order placement.

Warranty is one (1) year materials and labour.

Daily Rate and Travel Daily Rate, if quoted, includes hourly rate, accommodations, and meals. It does not include airfare.

Airfare, if quoted, is an estimated cost and assumes the flight is booked at least 14 days in advance. The actual air fare receipt will be provided and the final invoice adjusted accordingly. Airfare within North America is booked on the basis of fully flexible refundable economy class tickets with airline of choice.

Trojan employee on-site work will be performed during the working hours of 0830 – 1700 Monday through Friday except for statutory holidays. If site access/working hours are different from this then please advise and we will work to accommodate site hours.

Purchase order must state that "Canadian labor, service and technical support on site from Trojan Technologies is required". In addition, a "letter of invitation" on company letterhead will be requested after PO receipt. We will advise our requested wording (based on the PO received) to ensure it matches the PO, both of which will provide USA customs and passport control officers with the required supporting paperwork to allow our entry to complete work.

Vendor Quote for SCADA (Wonderware) Integration of EEM 1

Rich Davis

From:	Justin Colton [jdcolton@ocdautomation.com]
Sent:	Wednesday, September 3, 2014 2:25 PM
To:	Rich Davis
Cc:	Justin Colton
Subject:	City of Camas Numbers

UV System

Approach

- We would use 480V contactors to turn the UVs on and off. This was an idea proposed by a Trojan tech support person.
    - They do not publish nor are they willing to sell the protocol used to communicate with the UV boards.
- A new Compact Logix PLC with an analog input card (flow and intensities) and a relay output card would replace the SLC500.
- Intensity signals on the UV are 4-20mA. An on-board I to I isolator would allow the new Logix PLC to read the intensity values.
- Plant flow would be wired to the new PLC, or sent across the network.

Scope

- Site discovery
- Engineering/drafting
- PLC Programming, Wonderware programming, at the plant PC and locally
- PLC parts
    - Power supply
    - CPU
    - Relay output module
    - Analog input module
- Coordination with electrical contractor
- Startup and testing/tuning

Cost of SCADA integration only

Price:	$37,680
Suggested EC Budget:	$5,000 (including four 480V contactors)
Price if OCD does Wonderware only:	$8,800

Blower System

Approach

- Discovery time up front to determine I/O wiring, PLC network
- Bring the dissolved oxygen, flow signals into the Allen-Bradley PLC in the blower panel
- Control the existing valve network with the Allen-Bradley PLC, using the existing Pak Scan interface.
- Re-program the Red Lion converter to transfer any data required in the Modicon system
- Program to a control specification written by OCD Automation, approved by City of Camas and Abacus.

Scope

- Site discovery
- Engineering/drafting
- PLC Programming, Wonderware programming, at the plant PC and locally
- (18) I/I isolators for all of the D.O. and Flow signals currently wired to the Modicon
- Coordination with electrical contractor

1

Manufacturer documentation of UV power (kW) at various flows for existing UV3000 system (EEM 1) and for proposed new UV3000Plus system (EEM 2)

Rich Davis

From: Bill Reilly [bill@whreilly.com]
Sent: Friday, August 1, 2014 1:20 PM
To: Rich Davis; Bob Busch
Cc: Kim Batiste; Mike Reilly
Subject: FW: Trojan UV controls retrofit

Rich and Bob,

Here are the power numbers. We are working on the installation numbers and should have them by the end of next week.

Bill

Bill Reilly | Wm. H. Reilly & Co.
503-223-[illegible] Office | 503-223-[illegible] Fax | 503-314-[illegible] Cell
bill@whreilly.com

From: <Fournier>, Jordan Fournier <jfournier@trojanuv.com>
Date: Friday, August 1, 2014 at 12:34 PM
To: Bill Reilly <bill@whreilly.com>
Cc: Kim Batiste <kim@whreilly.com>, Mike Reilly <mreilly@whreilly.com>
Subject: RE: Trojan UV controls retrofit

Bill,

I have completed a spreadsheet showing the power consumption for both systems at flows ranging from 1 to 10 MGD.

	Power (kW)	
Flow (MGD)	3000	3000Plus
1	8.4	6.3
2	8.4	6.3
3	8.4	7.14
4	8.4	8.82
5	16.8	10.1
6	16.8	12.6
7	16.8	12.6
8	16.8	14.28
9	25.2	15.12
10	25.2	16.8

Let me know if you have any questions.
Regards
Jordan

Vendor Quote for Labor for EEM 1 & EEM 2

Rich Davis

From:	Bill Reilly [bill@whreilly.com]
Sent:	Wednesday, September 3, 2014 9:38 PM
To:	Rich Davis
Cc:	Bob Busch; Steve Rubbert; Kim Batiste
Subject:	Re: Camas UV installation options

Rich,

Add $4000 to the quote for installing the new 3000 Plus and $600 for installing the new control panel for the existing 3000 to get to prevailing wages.

Thanks.

Bill

Bill Reilly | Wm. H. Reilly & Co. | 503-223-6197 w | 503-314-8386 c

Sent from my iPhone. Please excuse typos.

On Sep 3, 2014, at 11:50 AM, "Rich Davis" <RichD@abacusrm.com> wrote:

> Bill,
>
> Does the original quote you provided for the 3000PLUS equipment ($225,000) include startup and programming by your company?
> I don't see anything in the quote below that includes this, and I noticed on the UV controls equipment you had a separate line item for programming startup and commissioning.
> Thanks in advance for the clarification.
>
> **Also, we are meeting with the Head of Public Works tomorrow morning to discuss these projects, so we need the quotes below updated with prevailing wages by the end of today.**
>
> Thanks in advance.
>
> Rich Davis
> Abacus
> 503-936-7163
>
> **From:** Bill Reilly [mailto:bill@whreilly.com]
> **Sent:** Tuesday, September 2, 2014 11:53 AM
> **To:** Rich Davis
> **Cc:** Bob Busch; Steve Rubbert; Kim Batiste
> **Subject:** Camas UV installation options
>
> Rich,
>
> I apologize for the delay. I thought these prices had already been sent to you. Please see below. I will also track down the prices on the existing control boards and get them over to you ASAP. Please let me know if you have any questions or require additional information.
>
> I hope this provides you with the information that you require at this time. Please let me know if you have any questions.
>
> Thanks.

1

Vendor Quote for Labor for EEM 1 & EEM 2 (continued)

Bill

Bill Reilly | Wm. H. Reilly & Co.
503-223-6197 Office | 503-223-0845 Fax | 503-314-8386 Cell
Bill@whreilly.com

Option 1 - Install new Trojan Technologies UV3000Plus and remove existing UV3000 system

OPTION 1 JOB TO INCLUDE LABOR, MATERIAL AND CLARIFICATIONS AS FOLLOWS:

1. Provide 2 480VAC 30KVA transformers to create the neutral necessary to power the system.
2. Provide labor and materials to install 2 PDCs, 4 Module Support Racks, 1 Expansion Baffle, 1 HSC, 1 ALC, 2 new 30 KVA transformers, and one new SCC.
3. Provide labor and materials to wire power, controls, and communication wiring for 2 PDCs, 1 HSC, 2 30 KVA transformers, and 1 new SCC.

Project Specific Exclusions:

1. PLC and SCADA programming and integration.
2. PDCs, the HSC, the SCC, the ALC and the expansion baffle are provided by Trojan Technologies and are not included in this price.
3. Prevailing wages not included.

Qualifications:

1. No back charges for clean up will be accepted unless prior written notice and forty eight (48) hours has been given to comply.
2. General Contractor/Owner shall submit construction schedule in electronic format as part of any subcontract and shall update the schedule weekly during the project.
3. Construction activities shall not commence, nor be scheduled, until applicable submittals have been approved.
4. All construction activities shall be coordinated with approved schedule. No construction activities shall commence less than seventy two (72) hours prior to corresponding change in construction schedule. In the event contractor's personnel are prohibited from performing scheduled activities, General Contractor/Owner shall be billed at contractor's "standby" rates until allowed to commence work or is dismissed by General Contractor. A two (2) hour minimum charge shall apply.
5. Equipment and materials supplied by the contractor are warranted only to the extent that the same are warranted by the manufacturer.
6. The contractor shall not be liable for indirect loss or damage.
7. If a formal contract is required, its' conditions must not deviate from this proposal without our permission.
8. Anything (verbal or written) expressed or implied elsewhere, which is contrary to these conditions shall be null and void.
9. Any alteration or deviation from the above specifications involving extra cost would be executed on written orders and will become an extra charge above and beyond the price listed.
10. This estimate is for completing the job as described above. It is based on our evaluation and does not include material price increases or additional labor or materials which may be required should unforeseen problems or adverse weather conditions occur after the work has started.
11. In the event suit or action is instituted to enforce any terms of this contract, the prevailing party shall be entitled to recover from the other party, such sum as the court may adjudge reasonable, as attorney fees at trial or on appeal of such suit or action, in addition to all other sums provided by law.

Additional Exclusions:

1. All applicable taxes are excluded in our submission.
2. The contractor shall not be held liable for errors or omissions in design by others, nor inadequacies of materials.
3. HVAC and Mechanical, controls, control wiring and starters unless specifically included above.
4. Unless included in this proposal, all bonding and/or special insurance requirements are supplied at additional cost.
5. Temporary power unless specifically included above.
6. All Utility costs and fees.
7. Trenching, backfilling and compaction.
8. Equipment and device mounting brackets and stands unless specifically included above.

Total Price for Option 1: $25,374.

Option 2 – Install new UV Control Panel for Existing Trojan UV3000 system

OPTION 2 JOB TO INCLUDE LABOR, MATERIAL AND CLARIFICATIONS AS FOLLOWS:

1. Labor to remove existing UV control panel.
2. Labor and materials to install new UV control panel.
3. Connect all wiring associated with the new UV control panel.
4. Install all existing conduits back into the new UV control panel.

Project Specific Exclusions:

2

Vendor Quote for Labor for EEM 1 & EEM 2 (continued)

1. Hamer Electric will not be providing the new UV control panel will be supplied by Trojan Technologies and is not included in this price.
2. PLC and SCADA programming and integration.
3. Prevailing wages not used.

Qualifications:

Same as items 1 – 11 above.

Exclusions

Same as items 1 – 8 above

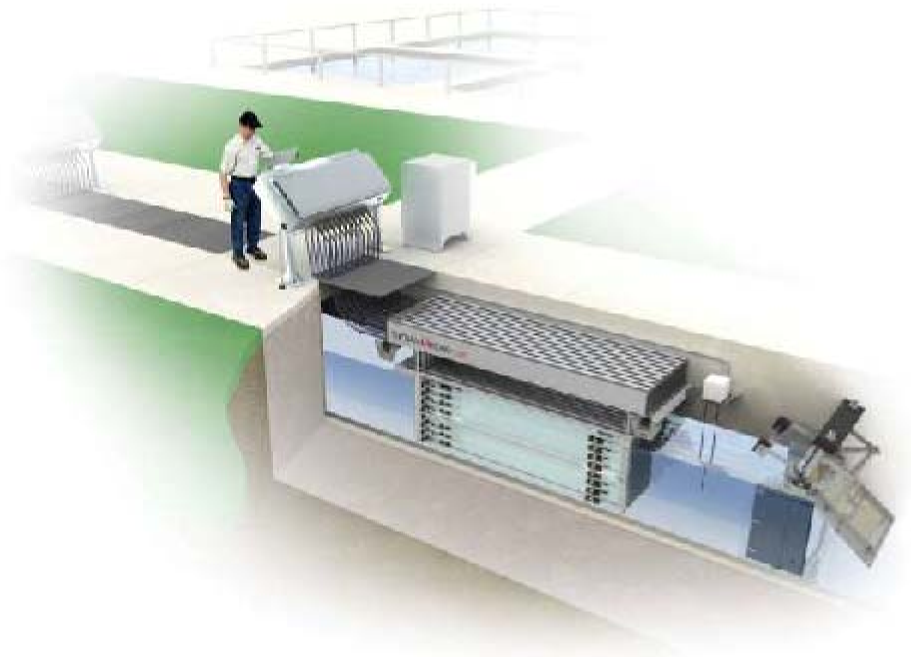
Total Price for Option 2: $2,694.39

3

Vendor Quote for EEM 2 – Install New UV System and Optimize UV System Controls

TROJANUV3000PLUS™

PROPOSAL FOR THE CITY OF CAMAS, WA
QUOTE: LJK1909
7/21/2014



The TrojanUV3000Plus™ is operating in over 1300 municipal wastewater plants around the world. Disinfecting over 17 billion gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

July 21, 2014

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Camas Replacement** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

Local Representative:
Bill Reilly, Jr.
WM. H. REILLY & CO.
910 S.W. 18th Avenue
Portland, OR 97205
USA
(503) 223-6197

DESIGN CRITERIA

CAMAS REPLACEMENT

Peak Design Flow:	**10.04 MGD**
UV Transmittance:	**70%** (minimum)
Total Suspended Solids:	**30 mg/l** (30 Day Average, grab sample)
Disinfection Limit:	**200 fecal coliform per 100 ml**, based on a 30 day Geometric Mean of consecutive daily grab samples
Design Dose:	**30,000 μWs/cm²**, bioassay validated
Validation Factors:	**0.98** end of lamp life factor (Low-Pressure Amalgam Lamps) **0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System)

Vendor Quote for EEM 2 – Install New UV System and Optimize UV System Controls (continued)

DESIGN SUMMARY

QUOTE: LJK1909

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

CHANNEL (Please reference Trojan layout drawings for details.)	
Number of Channels:	**1**
Approximate Channel Length Required:	**30 ft**
Channel Width Based on Number of UV Modules:	**28 in**
Channel Depth Recommended for UV Module Access:	**54 in**
UV MODULES	
Total Number of Banks:	**2**
Number of Modules per Bank:	**7**
Number of Lamps per Module:	**6**
Total Number of UV Lamps:	**84**
Maximum Power Draw:	**21 kW**
UV PANELS	
Power Distribution Center Quantity:	**2**
System Control Center Quantity:	**1**
MISCELLANEOUS EQUIPMENT	
Level Controller Quantity:	**1**
Type of Level Controller:	**Weighted Gate (ALC)**
Automatic Chemical / Mechanical Cleaning:	**Trojan ActiClean-WW™**
UV Module Lifting Device:	**Davit Crane**
Standard Spare Parts / Safety Equipment:	**Included**
Other Equipment:	
ELECTRICAL REQUIREMENTS	

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 16.6 kVA.
2. The Hydraulic System Center requires an electrical power supply that is powered from the Power Distribution Center.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. Electrical disconnects required per local code are not included in this proposal.

Camas Replacement
7/21/2014 - 3 - LJK1909

Vendor Quote for EEM 2 – Install New UV System and Optimize UV System Controls (continued)

COMMERCIAL INFORMATION

Total Capital Cost: $225,000 (US$)

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

Camas Replacement
7/21/2014 - 4 - LJK1909

Note: This is material quote only, labor quote received separately via email.

Vendor Quote for EEM 3 – Optimize Aeration System Controls

Control and Electrical Systems Engineering

Control Engineers, PA

August 25, 2014

Rich Davis
Abacus Resource Management

RE: Camas, WA WWTP Energy Improvements

Dear Rich:

Control Engineers is pleased to provide this proposal for the Camas WWTP project. This proposal is based on information taken from a site visit on 8/13/2014 and from subsequent information provided by Bob Busch. The aeration system and the UV system were the main areas of focus.

Aeration System
The system consists of master blower control panel (MBCP), four centrifugal blowers on VFDs, each with their own control panel, tied to a common air header which feed three aeration basins and a septage receiving station. Each aeration basin has three zones and each zone has a dissolved oxygen (DO) meter, air flow meter and a modulating air flow control valve (FCV). The blowers are supposed to maintain the header pressure and the FCVs are supposed to modulate in order to maintain the DO set-point for each zone in each basin. The FCVs are connected to a Pakscan 2s device that controls the valves over a two wire current loop and reports valve status back to the various PLCs.

According to plant personnel, the aeration system has never worked properly. Currently, the operators manually control the number of blowers, each blowers speed and the individual valve positions. The exact reason for the system not working properly is unknown but the likely culprits are:

- Incorrect programming of the Pakscan device
- Corrupt or faulty Pakscan device
- Incorrect programming of the MBCP
    - This could be the Allen Bradley PLC, the Red Lion protocol converter or even the Digi Ethernet to Serial converter

As part of this proposal, we have included the cost to replace the Pakscan device as it is by far the most expensive item. Should any other device require replacing, it will be covered by the Pakscan cost. It should be noted that the Pakscan 2s model has been superseded by the P3 model.

Per the owner's request, we are providing a line item to replace the aeration blower VFDs. It is our intent to use the existing enclosure and retrofit it with the new VFD.

Our scope of work includes:

- Diagnosing and documenting how the various pieces of equipment communicate and their functions.

(208) 433-9997 fax(208) 426-0550 www.control-engineers.com 1095 S. Federal Way, Boise, Idaho 83705

Vendor Quote for EEM 3 – Optimize Aeration System Controls (continued)

- Analyze the PLC programming and make changes as necessary to implement the Most Open Valve control technique. This includes PLCs, Pakscan device, protocol converters, HMIs and SCADA.
- Provide onsite system testing and four hours of training. A revised sequence of operations will be provided in PDF format
- Provide four new aeration blower variable frequency drives.
    - Each drive shall be a Square D Altivar 71 series, 150HP, constant torque unit
    - We will provide connection diagrams and drive configuration services
    - Drive installation is not included in this scope
    - We have also included the cost of a site visit by a HSI technician to re-program the individual blower PLCs should the need arise due to the change in VFDs

A summary of estimated costs for the Aeration System Improvements is shown below:

Description	Labor / Expense Cost	Equipment Cost	Subtotal
Diagnose and Fix Aeration Controls	$32,695	$18,113	$50,807
Provide four blower VFDs	$9,028	$64,118	$73,146
Total			**$123,954**

UV System
The UV system consists of a master control panel (MCP) and four UV banks. According to plant personnel, this system does not function correctly so the operators run all four banks in a manual mode. The SCADA system has no feedback from the UV system whatsoever. According to some of the documentation provided, it appears that at some time in the past, the original MCP was replaced by a company called MethodWorks and that the replacement project did not go well. The scope and extent of what was accomplished by MethodWorks is unknown as they have refused to speak to us about it.

We believe that the master PLC has lost its program, judging from the LED indicators on the processor. In order for Control Engineers to fix the UV dosing system program, the City would need to get a copy of the program from Methodworks so that the appropriate fixes could be made. The cost to perform these fixes would certainly be less than the cost to replace the system as quoted by Trojan, but is undeterminable without a copy of the program from Methodworks. We believe it is Methodworks' responsibility to provide this program to the City, but they will not give it to Control Engineers. If this is not possible, then we recommend that Abacus contract directly with Trojan to replace the MCP as previously quoted by Trojan.

We look forward to the opportunity to work with you on this project. Thank you for your consideration and please contact me if you have any questions or concerns with this proposal.

Sincerely,

Anthony Chris Cocozzo
Project Manager

(208) 433-9997 fax(208) 426-0550 www.control-engineers.com 1095 S. Federal Way, Boise, Idaho 83705