Comprehensive Energy Audit
For
Water Treatment Plant & Washeteria

Prepared For
Pitkas Point Village Council

March 6, 2013

Prepared By:

ANTHC-DEHE
3900 Ambassador Drive, Suite 301
Anchorage, AK 99508

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PREFACE

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for the Native Village of Pitkas Point. The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and Gavin Dixon.

The purpose of this report is to provide a comprehensive document that summarizes the findings and analysis that resulted from an energy audit conducted over the past couple months by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy efficiency measures. Discussions of site specific concerns and an Energy Efficiency Action Plan are also included in this report.

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of the staff of the water plant, washeteria, and the Native Village of Pitkas Point.

1. EXECUTIVE SUMMARY

This report was prepared for the ARUC. The scope of the audit focused on Water Treatment Plant & Washeteria. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, HVAC systems, and plug loads.

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are $25,554 for Electricity, $35,954 for #1 Oil, with total energy costs of $61,508 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the State of Alaska last year. If this facility had not received PCE, total electrical costs would have been $39,928.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Water Treatment Plant & Washeteria. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Other Electrical - Controls Retrofit: Raw Water Glycol Pump	Shut off pump in the summer time.	$644	$10	398.89	0.0
2	Other Electrical - Controls Retrofit: Water Circulation Pump	Shut off pump in the summer time.	$790	$20	221.27	0.0
3	Other Electrical - Controls Retrofit: WST Glycol Pump	Shut off pump in the summer time.	$231	$10	143.29	0.0
4	Other Electrical - Controls Retrofit: Well 1 Heat Trace	Shut off well heat trace, the glycol line should prevent freezing.	$4,255	$200	131.68	0.0
5	Ventilation	Repair controls, and disable the occupancy sensor in the water plant, so ventilation system only runs when washeteria is occupied.	$14,063	$2,000	92.82	0.1
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9	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$603	$1,500	5.44	2.5
10	Lighting - Power Retrofit: Exterior Lights	Replace with 2 LED 20W Module Electronic Fixtures	$116 + $25 Maint. Savings	$600	1.99	5.2
11	HVAC And DHW	Make sure the washeteria operates the hot water only on days the washeteria is in operation.	$276	$2,500	1.93	9.1
12	Water Distribution and Heating	Add arctic enclosure to generator, shut off the heat tape. The glycol line should prevent freezing in the facility.	$2,870	$30,000	1.19	10.5
	TOTAL, all measures		**$27,574 + $25 Maint. Savings**	**$38,740**	**7.73**	**1.4**

Table Notes:

[1] Savings to Investment Ratio (SIR) is a life-cycle cost measure calculated by dividing the total savings over the life of a project (expressed in today's dollars) by its investment costs. The SIR is an indication of the profitability of a measure; the higher the SIR, the more profitable the project. An SIR greater than 1.0 indicates a cost-effective project (i.e. more savings than cost). Remember that this profitability is based on the position of that Energy Efficiency Measure (EEM) in the overall list and assumes that the measures above it are implemented first.

[2] Simple Payback (SP) is a measure of the length of time required for the savings from an EEM to payback the investment cost, not counting interest on the investment and any future changes in energy prices. It is calculated by dividing the investment cost by the expected first-year savings of the EEM.

With all of these energy efficiency measures in place, the annual utility cost can be reduced by $27,574 per year, or 44.8% of the buildings' total energy costs. These measures are estimated to cost $38,740, for an overall simple payback period of 1.4 years.

Table 1.2 below is a breakdown of the annual energy cost across various energy end use types, such as Space Heating and Water Heating. The first row in the table shows the breakdown for the building as it is now. The second row shows the expected breakdown of energy cost for the building assuming all of the retrofits in this report are implemented. Finally, the last row shows the annual energy savings that will be achieved from the retrofits.

Table 1.2 Annual Energy Cost Estimate										
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Lighting**	**Refrigeration**	**Other Electrical**	**Water Distribution and Heating**	**Clothes Drying**	**Ventilation Fans**	**Total Cost**
Existing Building	$20,290	$0	$3,352	$1,948	$0	$15,465	$12,271	$4,816	$3,366	**$61,508**
With All Proposed Retrofits	$8,745	$0	$3,000	$1,831	$0	$5,301	$9,401	$4,816	$842	**$33,935**
SAVINGS	$11,545	$0	$352	$116	$0	$10,165	$2,870	$0	$2,525	**$27,574**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Water Treatment Plant & Washeteria. The scope of this project included evaluating building shell, lighting and other electrical systems, and HVAC equipment, motors and pumps. Measures were analyzed based on life-cycle-cost techniques, which include the initial cost of the equipment, life of the equipment, annual energy cost, annual maintenance cost, and a discount rate of 3.0%/year in excess of general inflation.

2.2 Audit Description

Preliminary audit information was gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is used and what opportunities exist within a building. The entire site was surveyed to inventory the following to gain an understanding of how each building operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Building-specific equipment
- Water consumption, treatment (optional) & disposal

The building site visit was performed to survey all major building components and systems. The site visit included detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the building manager were collected along with the system and components to determine a more accurate impact on energy consumption.

Details collected from Water Treatment Plant & Washeteria enable a model of the building's energy usage to be developed, highlighting the building's total energy consumption, energy consumption by specific building component, and equivalent energy cost. The analysis involves distinguishing the different fuels used on site, and analyzing their consumption in different activity areas of the building.

Water Treatment Plant & Washeteria is classified as being made up of the following activity areas:

1) Water Treatment Plant: 1,040 square feet
2) Washeteria: 1,120 square feet

In addition, the methodology involves taking into account a wide range of factors specific to the building. These factors are used in the construction of the model of energy used. The factors include:

- Occupancy hours
- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

Data collected was processed using AkWarm© Energy Use Software to estimate energy savings for each of the proposed energy efficiency measures (EEMs). The recommendations focus on the building envelope; HVAC; lighting, plug load, and other electrical improvements; and motor and pump systems that will reduce annual energy consumption.

EEMs are evaluated based on building use and processes, local climate conditions, building construction type, function, operational schedule, existing conditions, and foreseen future plans. Energy savings are calculated based on industry standard methods and engineering estimations.

Our analysis provides a number of tools for assessing the cost effectiveness of various improvement options. These tools utilize **Life-Cycle Costing**, which is defined in this context as a method of cost analysis that estimates the total cost of a project over the period of time that includes both the construction cost and ongoing maintenance and operating costs.

Savings to Investment Ratio (SIR) = **Savings** divided by **Investment**

Savings includes the total discounted dollar savings considered over the life of the improvement. When these savings are added up, changes in future fuel prices as projected by the Department of Energy are included. Future savings are discounted to the present to account for the time-value of money (i.e. money's ability to earn interest over time). The **Investment** in the SIR calculation includes the labor and materials required to install the measure. An SIR value of at least 1.0 indicates that the project is cost-effective—total savings exceed the investment costs.

Simple payback is a cost analysis method whereby the investment cost of a project is divided by the first year's savings of the project to give the number of years required to recover the cost of the investment. This may be compared to the expected time before replacement of the system or component will be required. For example, if a boiler costs $12,000 and results in a savings of $1,000 in the first year, the payback time is 12 years. If the boiler has an expected life to replacement of 10 years, it would not be financially viable to make the investment since the payback period of 12 years is greater than the project life.

The Simple Payback calculation does not consider likely increases in future annual savings due to energy price increases. As an offsetting simplification, simple payback does not consider the need to earn interest on the investment (i.e. it does not consider the time-value of money). Because of these simplifications, the SIR figure is considered to be a better financial investment indicator than the Simple Payback measure.

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

It is important to note that the savings for each recommendation is calculated based on implementing the most cost effective measure first, and then cycling through the list to find the next most cost effective measure. Implementation of more than one EEM often affects the savings of other EEMs. The savings may in some cases be relatively higher if an individual EEM is implemented in lieu of multiple recommended EEMs. For example implementing a reduced operating schedule for inefficient lighting will result in relatively high savings. Implementing a reduced operating schedule for newly installed efficient lighting will result in lower relative savings, because the efficient lighting system uses less energy during each hour of operation. If multiple EEM's are recommended to be implemented, AkWarm calculates the combined savings appropriately.

Cost savings are calculated based on estimated initial costs for each measure. Installation costs include labor and equipment to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers.

2.4 Limitations of Study

All results are dependent on the quality of input data provided, and can only act as an approximation. In some instances, several methods may achieve the identified savings. This report is not intended as a final design document. The design professional or other persons following the recommendations shall accept responsibility and liability for the results.

3. Water Treatment Plant & Washeteria

3.1. Building Description

The 2,160 square foot Water Treatment Plant & Washeteria was constructed in 2011, with a normal occupancy of 1 person. The number of hours of operation for this building average 6 hours per day, considering all seven days of the week.

The building was just constructed in the last few years and is in very good condition.

Description of Building Shell

The exterior walls are 2x6 construction with 5.5 inches of polyurethane insulation.

The roof of the building is a warm roof with six inches of polyurethane insulation.

The floor of the building is built on pilings with six inches of polyurethane insulation.

Typical windows throughout the building are double paned windows with vinyl frames.

Doors are metal with a polyurethane core.

Description of Heating Plants

The Heating Plants used in the building are:

Weil McLain Gold
Nameplate Information: WGO Series 3
Fuel Type: #1 Oil
Input Rating: 268,000 BTU/hr
Steady State Efficiency: 85 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year
Notes: Primary loop pump runs when boiler runs, included in boiler power.

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Steady State Efficiency: 85 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: Sep - Jun
Notes: Primary loop pump included with boiler, runs when boiler runs.

Space Heating Distribution Systems

Unit heaters provide heat to the facility.

Domestic Hot Water System

Currently a 120 gallon hot water heater with R-10 insulation is heated by the boilers. The facility consumes an average of 110 gallons of water per day over the course of the year. The washeteria is responsible for the vast majority of this load. The hot water is currently circulated 24 hours a day, all year long and is kept at 135 degrees.

Description of Building Ventilation System

The washeteria ventilation system is designed to only operate when washeteria is open but it is operating constantly now. 90% of the air goes to washeteria, 10% to water plant, motion sensors detect whether anyone is in the facility, if no one is in the facility it should shut off.

Lighting

Electronic Fluorescent T8 fixtures with 32 watt bulbs makes up the lighting in the facility. Exterior lighting is made up of a pair of 70 watt metal halide fixtures.

Major Equipment

Major energy using equipment in the facility is included in this list.

The new water storage tank uses approximately 30,000 btu per hour during the winter. A heat tape is currently adding additional unnecessary freeze protection.

A single circulation loop distributes water to the town, water is circulated by a 3 horsepower circulation pump. Water is heated in the water plant and uses about 20,000 btu/hour during the winter. A heat tape is currently adding additional unnecessary freeze protection.

An exterior generator (Describe) is kept warm with both a glycol line and an unnecessary heat tape.

There are two exhaust fans in the facility, a chemical room ventilation fan, and four washing machines in the washeteria.

There are three dryers which use approximately 65,000 btu/hr when in operation.

A 900 watt glycol pump circulates glycol throughout the facility and has a VFD, which maintains the workload on the pump at about 600 watts.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

The natural gas usage profile shows the predicted natural gas energy usage for the building. If actual gas usage records were available, the model used to predict usage was calibrated to approximately match actual usage. Natural gas is sold to the customer in units of 100 cubic feet (CCF), which contains approximately 100,000 BTUs of energy.

The propane usage profile shows the propane usage for the building. Propane is sold by the gallon or by the pound, and its energy value is approximately 91,800 BTUs per gallon.

The fuel oil usage profile shows the fuel oil usage for the building. Fuel oil consumption is measured in gallons. One gallon of #1 Fuel Oil provides approximately 132,000 BTUs of energy.

The following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: AVEC-St.Mary's/Adref/Pitkas - Commercial - Sm

The average cost for each type of fuel used in this building is shown below in Table 3.1. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.1 – Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.32/kWh
#1 Oil	$ 6.96/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, ARUC pays approximately $61,508 annually for electricity and other fuel costs for the Water Treatment Plant & Washeteria.

Figure 3.1 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the "Retrofit" bar in the figure to the "Existing" bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

Figure 3.1
Annual Energy Costs by End Use

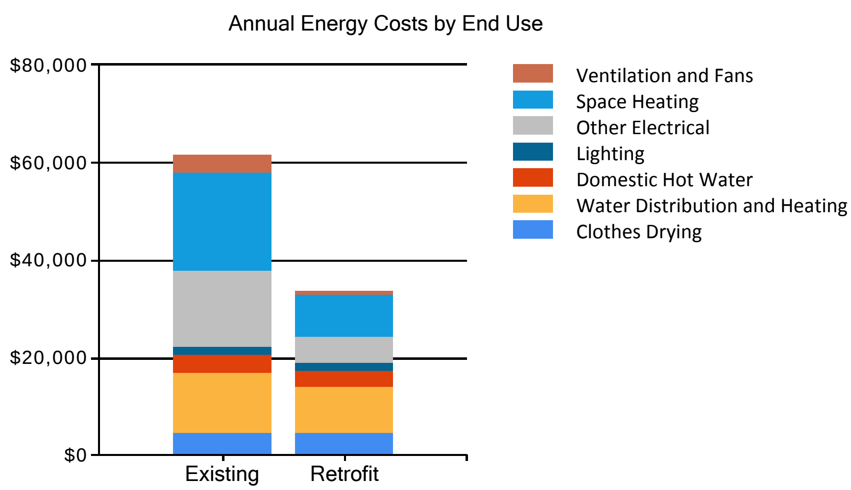


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The "Existing" bar shows the breakdown for the building as it is now; the "Retrofit" bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

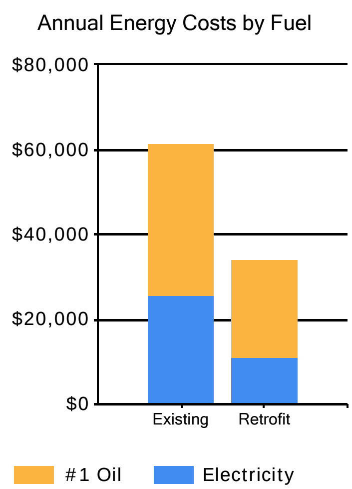
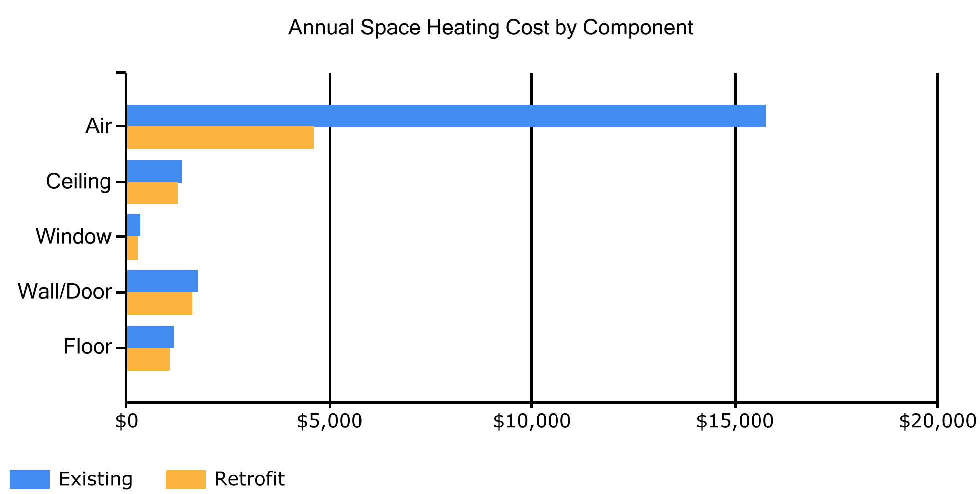


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
Annual Space Heating Cost by Component



The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Other_Electrical	5327	4855	5327	5155	5327	2324	2402	2402	2324	2402	5155	5327
Lighting	517	471	517	500	517	500	517	517	500	517	500	517
Water Distribution and Heating	850	775	850	823	850	0	0	0	0	0	823	850
Clothes_Drying	234	213	234	226	234	226	234	234	226	234	226	234
Ventilation_Fans	893	814	893	864	893	864	893	893	864	893	864	893
DHW	11	10	11	10	11	12	14	13	11	11	10	11
Space_Heating	635	574	605	528	472	410	411	418	439	522	559	635

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Water Distribution and Heating	218	199	218	211	218	0	0	0	0	0	211	218
Clothes_Drying	48	44	48	46	48	46	48	48	46	48	46	48
DHW	35	32	35	35	40	47	55	51	41	37	34	35
Space_Heating	414	371	364	254	138	26	2	15	103	221	307	415

3.2.2 Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (Btu) or kBtu, and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.
The site and source EUIs for this building are calculated as follows. (See Table 3.4 for details):

Building Site EUI = *(Electric Usage in kBtu + Fuel Oil Usage in kBtu)* / *Building Square Footage*

Building Source EUI = *(Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio)* / *Building Square Footage*

where "SS Ratio" is the Source Energy to Site Energy ratio for the particular fuel.

Table 3.4
Water Treatment Plant & Washeteria EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	79,856 kWh	272,550	3.340	910,318
#1 Oil	5,166 gallons	681,885	1.010	688,704
Total		**954,435**		**1,599,022**
BUILDING AREA		2,160	Square Feet	
BUILDING SITE EUI		442	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		740	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

3.3 AkWarm© Building Simulation

An accurate model of the building performance can be created by simulating the thermal performance of the walls, roof, windows and floors of the building. The HVAC system and central plant are modeled as well, accounting for the outside air ventilation required by the building and the heat recovery equipment in place.

The model uses local weather data and is trued up to historical energy use to ensure its accuracy. The model can be used now and in the future to measure the utility bill impact of all types of energy projects, including improving building insulation, modifying glazing, changing air handler schedules, increasing heat recovery, installing high efficiency boilers, using variable air volume air handlers, adjusting outside air ventilation and adding cogeneration systems.

For the purposes of this study, the Water Treatment Plant & Washeteria was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Saint Mary's was used for analysis. From this, the model was be calibrated to predict the impact of theoretical energy savings measures. Once annual energy savings from a particular measure were predicted and the initial capital cost was estimated, payback scenarios were approximated. Equipment cost estimate calculations are provided in Appendix D.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Saint Mary's. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.

• The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.

• The model does not model HVAC systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

The energy balances shown in Section 3.1 were derived from the output generated by the AkWarm© simulations.

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

The energy saving measures are summarized in Table 4.1. Please refer to the individual measure descriptions later in this report for more detail. Calculations and cost estimates for analyzed measures are provided in Appendix C.

Table 4.1 Water Treatment Plant & Washeteria, Saint Mary's, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
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	TOTAL, all measures		**$27,574 + $25 Maint. Savings**	**$38,740**	**7.73**	**1.4**

4.2 Interactive Effects of Projects

The savings for a particular measure are calculated assuming all recommended EEMs coming before that measure in the list are implemented. If some EEMs are not implemented, savings for the remaining EEMs will be affected. For example, if ceiling insulation is not added, then savings from a project to replace the heating system will be increased, because the heating system for the building supplies a larger load.

In general, all projects are evaluated sequentially so energy savings associated with one EEM would not also be attributed to another EEM. By modeling the recommended project sequentially, the analysis accounts for interactive affects among the EEMs and does not "double count" savings.

Interior lighting, plug loads, facility equipment, and occupants generate heat within the building. When the building is in cooling mode, these items contribute to the overall cooling demands of the building; therefore, lighting efficiency improvements will reduce cooling requirements in air-conditioned buildings. Conversely, lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties and cooling benefits were included in the lighting project analysis.

4.3 Mechanical Equipment Measures

4.3.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation				
11	Make sure the washeteria operates the hot water only on days the washeteria is in operation.				
Installation Cost	$2,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$276
Breakeven Cost	$4,828	**Savings-to-Investment Ratio**	1.9	**Simple Payback yrs**	9
Auditors Notes: The hot water should also only be maintained at 120 degrees.					

4.3.2 Ventilation System Measures

Rank	Description	Recommendation			
5		Repair controls so ventilation system only runs when washeteria is occupied			
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$14,063
Breakeven Cost	$185,648	**Savings-to-Investment Ratio**	92.8	**Simple Payback yrs**	0
Auditors Notes: The occupancy sensors in both the washeteria and water plant are not working. The controls should be redone, and set to run only when the washeteria is in operation to provide make up air for the dryers. The water plant does not need make up air					

4.3.3 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
8	Washeteria	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Washeteria space.			
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$688
Breakeven Cost	$9,291	**Savings-to-Investment Ratio**	6.2	**Simple Payback yrs**	2
Auditors Notes: A setback thermostat should be installed and programmed to keep the facility heated to only 60 degrees when the facility is unoccupied.					

Rank	Building Space	Recommendation			
9	Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.			
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$603
Breakeven Cost	$8,153	**Savings-to-Investment Ratio**	5.4	**Simple Payback yrs**	2
Auditors Notes: A setback thermostat should be installed and programmed to keep the facility heated to only 60 degrees when the facility is unoccupied. :					

4.4 Electrical & Appliance Measures

4.4.1 Lighting Measures

The goal of this section is to present any lighting energy conservation measures that may also be cost beneficial. It should be noted that replacing current bulbs with more energy-efficient equivalents will have a small effect on the building heating and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.4.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	**Location**	**Existing Condition**		**Recommendation**	
10	Exterior Lights	2 MH 70 Watt Electronic with Manual Switching		Replace with 2 LED 20W Module Electronic	
Installation Cost	$600	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$116
				Maintenance Savings (/yr)	$25
Breakeven Cost	$1,193	**Savings-to-Investment Ratio**	2.0	**Simple Payback yrs**	5
Auditors Notes: Replacing current fixtures with LED's will reduce electrical usage, reduce bulb replacements, and improve performance in the cold.					

4.5.3 Other Electrical Measures

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
1	Raw Water Glycol Pump	Grundfos Pump with Manual Switching		Improve Manual Switching	
Installation Cost	$10	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$644
Breakeven Cost	$3,989	**Savings-to-Investment Ratio**	398.9	**Simple Payback yrs**	0
Auditors Notes: This pump can be shut off in the summer time.					

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
2	Water Circulation Pump	Pump Motor with Manual Switching		Improve Manual Switching	
Installation Cost	$20	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$790
Breakeven Cost	$4,425	**Savings-to-Investment Ratio**	221.3	**Simple Payback yrs**	0
Auditors Notes: The Water Circulation Pump can be shut off in the summer time.					

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
3	WST Glycol Pump	Grundfos Pump with Manual Switching		Improve Manual Switching	
Installation Cost	$10	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$231
Breakeven Cost	$1,433	**Savings-to-Investment Ratio**	143.3	**Simple Payback yrs**	0
Auditors Notes: This pump can be shut off in the summer time.					

Rank	Location	Description of Existing	Efficiency Recommendation		
4	Well 1 Heat Trace	Electric Heat Tape with Manual Switching	Improve Manual Switching		
Installation Cost	$200	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$4,255
Breakeven Cost	$26,336	**Savings-to-Investment Ratio**	131.7	**Simple Payback yrs**	0
Auditors Notes: Shut off electric heat tape, the well line is heated with a glycol loop off the boiler.					

Rank	Location	Description of Existing	Efficiency Recommendation		
6	Well 2 Heat Trace	Electric Heat Tape with Manual Switching	Improve Manual Switching		
Installation Cost	$200	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$2,155
Breakeven Cost	$13,340	**Savings-to-Investment Ratio**	66.7	**Simple Payback yrs**	0
Auditors Notes: The electric heat tape should not be on, the well line is heated by a glycol loop off the boiler.					

Rank	Location	Description of Existing	Efficiency Recommendation		
7	WST Heat Trace	Electric Heat Tape with Manual Switching	Improve Manual Switching		
Installation Cost	$200	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$882
Breakeven Cost	$5,459	**Savings-to-Investment Ratio**	27.3	**Simple Payback yrs**	0
Auditors Notes: There is no need for the heat tape to be on, the water storage tank has a glycol heat loop off the boiler.					

4.5.4 Water Distribution and Heating Measures

Rank	Location	Description of Existing	Efficiency Recommendation		
12			Add arctic enclosure to generator, shut off heat tape, and use only glycol.		
Installation Cost	$30,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$2,870
Breakeven Cost	$35,553	**Savings-to-Investment Ratio**	1.2	**Simple Payback yrs**	10
Auditors Notes: The generator can be heated more efficiently if it is enclosed.					

5. ENERGY EFFICIENCY ACTION PLAN

Through inspection of the energy-using equipment on-site and discussions with site facilities personnel, this energy audit has identified several energy-saving measures. The measures will reduce the amount of fuel burned and electricity used at the site. The projects will not degrade the performance of the building and, in some cases, will improve it.

Several types of EEMs can be implemented immediately by building staff, and others will require various amounts of lead time for engineering and equipment acquisition. In some cases, there are logical advantages to implementing EEMs concurrently. For example, if the same electrical contractor is used to install both lighting equipment and motors, implementation of these measures should be scheduled to occur simultaneously.

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

Lighting
Illumination Engineering Society - http://www.iesna.org/

Energy Star Compact Fluorescent Lighting Program - www.energystar.gov/index.cfm?c=cfls.pr_cfls

DOE Solid State Lighting Program - http://www1.eere.energy.gov/buildings/ssl/

DOE office of Energy Efficiency and Renewable Energy - http://apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?c=lighting.pr_lighting

Hot Water Heaters

Heat Pump Water Heaters -
http://apps1.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12840

Solar Water Heating

FEMP Federal Technology Alerts – http://www.eere.energy.gov/femp/pdfs/FTA_solwat_heat.pdf

Solar Radiation Data Manual – http://rredc.nrel.gov/solar/pubs/redbook

Plug Loads

DOE office of Energy Efficiency and Renewable Energy – http:apps1.eere.energy.gov/consumer/your_workplace/

Energy Star – http://www.energystar.gov/index.cfm?fuseaction=find_a_product

The Greenest Desktop Computers of 2008 - http://www.metaefficient.com/computers/the-greenest-pcs-of-2008.html

Wind

AWEA Web Site – http://www.awea.org

National Wind Coordinating Collaborative – http:www.nationalwind.org

Utility Wind Interest Group site: http://www.uwig.org

WPA Web Site – http://www.windpoweringamerica.gov

Homepower Web Site: http://homepower.com

Windustry Project: http://www.windustry.com

Solar

NREL – http://www.nrel.gov/rredc/

Firstlook – http://firstlook.3tiergroup.com

TMY or Weather Data – http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/

State and Utility Incentives and Utility Policies - http://www.dsireusa.org