Comprehensive Energy Audit
For
Water and Sewer System

Prepared For

Village of Lower Kalskag

August 17, 2011

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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 Lower Kalskag. The authors of this report are Carl H. Remley, Certified Energy Auditor (CEA) and Certified Energy Manager (CEM) 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 Paul Even Jr. Water Treatment Plant Operator for the Native Village of Lower Kalskag, and Ms. Marcie Sherer, AVCP.

1. EXECUTIVE SUMMARY

This report was prepared for the Native Village of Lower Kalskag. The scope of the audit focused on Water Treatment Plant and sanitation systems. 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 $10,683 for Electricity, $6,578 for #1 Oil. And total energy costs of $17,261 per year.

This report combines data for the two associated waste water lift stations. These two stations collect waste water via a gravity sewer lines, transfer waste via force main to the sewage lagoon.

It should be noted that these facilities received the power cost equalization (PCE) subsidy from the state of Alaska. If the facilities had not received the PCE subsidy, total electrical costs would be $39,883, fuel costs would be $6,578, and total energy costs would be $46,461.

Table 1.1 below summarizes the energy efficiency measures analyzed for the Water Treatment Plant. 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	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$363	$700	7.77	1.9
2	Other Electrical: Well #1 Heat tape	Improve Manual Switching	$16	$50	1.98	3.1

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]
3	HVAC And DHW	Piping insulation to limit losses and increase efficiency. Install summer nozzles to increase burn time and limit cycling in the summer months as well as the spring and fall. By isolating the inactive boiler, jacket losses can be reduced. Excessive sooting / electrodes are burnt and need to be replaced ("retro-commissioned"). Tips needed to be replaced. Also excessive air band settings are decreasing potential efficiency.	$363	$4,200	1.67	11.6
4	Other Electrical: Heat tape to well house	Replace with Heat tape and Controls retrofit	$1,301	$5,100	1.63	3.9
5	Other Electrical: Lift Station #2 Electric Heat	Improve Manual Switching	$123	$600	1.31	4.9
6	Other Electrical: Lift Station #1 Electric Heat	Improve Manual Switching	$123	$600	1.31	4.9
7	Other Electrical: Pressure Pumps	Replace with Goulds Pump and Improve Other Controls	$266	$2,100	1.03	7.9
	TOTAL, all measures		**$2,555**	**$13,350**	**1.84**	**5.2**

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 $2,555 per year, or 14.8% of the buildings' total energy costs. These measures are estimated to cost $13,350, for an overall simple payback period of 5.2 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	Other Electrical	Water Tank Heat	Circulation Loops Heat	Ventilation Fans	Service Fees	Total Cost
Existing Building	$1,832	$0	$0	$255	$7,050	$598	$7,527	$0	$0	**$17,261**
With All Proposed Retrofits	$1,223	$0	$0	$255	$5,103	$598	$7,527	$0	$0	**$14,707**
SAVINGS	$609	$0	$0	$0	$1,946	$0	$0	$0	$0	**$2,555**

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. 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

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 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 is classified as being made up 1512 square feet of water treatment plant space.

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

3.1. Building Description

The 1,512 square foot Water Treatment Plant was constructed in 1982, with a normal occupancy of one person. The building is in operation two hours per day, seven days a week on average.

Description of Building Shell

The exterior walls are constructed around a structural steel frame, the wall thickness is 6 inches, and is believed to consist of nearly 5.5 inches of polyurethane foam.

The structural steel frame is continuous across the span o the roof, allowing for a prefabricated insulated panel warm roof insulation package. The roof is believed to consist of interlocked 8 inch polyurethane foam insulated panels and covered with protective standing seam steel sheathing.

The WTP flooring systems consists of 8 inch insulated panels laid on an elevated frame. The insulation is encapsulated by plywood on either side. The interior of the facility has a protective polyurea coating installed which is in marginal condition. Concrete islands serve as support for equipment such as boilers and pumps.

Typical windows throughout the building are small wood framed, double pane, and awning style windows.

The only entrance is a metal un-insulated door, sheltered by an unheated arctic entry.

Description of Heating and Cooling Plants

The Heating Plants used in the building are:

Boiler #1
Nameplate Information: Weil Mclain Gold oil
Model # WGO-7 Series - 3
Becket Burner
Model # AFG
Nozzle 2.00
Angle 70B

Fuel Type:	#1 Oil
Input Rating:	242,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.2 %
Heat Distribution Type:	Water
Boiler Operation:	Oct - May
Notes:	ONLY ONE BOILER AND CIRC PUMP RUNS AT A TIME.

Boilers need to be serviced by qualified personnel with access to combustion analyses equipment. Excessive sooting / electrodes are burnt and need to be replaced. Nozzles need to be replaced. Also excessive air band settings are decreasing efficiency, and producing excessive stack air temperatures. Install summer nozzles to increase burn time and limit cycling in the spring and fall months. Boiler jacket losses can be limited by isolating the inactive boiler.

Piping insulation will limit system losses and increase efficiency.

Boiler # 2

Nameplate Information:	Weil McLain Gold oil

Model # WGO-7 Series - 3
Becket Burner
Model # AFG
Nozzle 2.00
Angle 70B

Fuel Type:	#1 Oil
Input Rating:	242,000 BTU/hr
Steady State Efficiency:	72 %
Idle Loss:	1.2 %
Heat Distribution Type:	Water
Boiler Operation:	Oct - May
Notes:	ONLY ONE BOILER AND CIRC PUMP RUNS AT A TIME.

Monitor 2400

Nameplate Information:	Monitor 2400 120V 2.8Amps 50/60 Hz
Fuel Type:	#1 Oil
Input Rating:	43,000 BTU/hr
Steady State Efficiency:	87 %
Idle Loss:	0.5 %
Heat Distribution Type:	Air
Notes:	on at 65 off at 70

Space Heating Distribution Systems

The buildings space heating load is carried entirely by the Monitor heater. The boilers provide much of the heat through jacket losses, but they are operating to supply heat to the circulation loops and the water storage tank.

Lighting

Lighting Loads in the building are made up entirely of 32 watt four foot light bulbs in T* electronic ballast fixtures.

Plug Loads

There is a computer and monitor for plug loads. Other plug loads in the building include heat tapes.

Lift Stations

The two lift stations are heated electrically and operate with two submersible pumps each. The submersible pumps runs about 17% of the time in each lift station and the stations are heated to room temperature comfortable levels all year long.

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

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-Lwr/Upr Kalskag - 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	$ 0.15/kWh
#1 Oil	$ 3.38/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Alaska Rural Utility Collaborative pays approximately $17,261 annually for electricity and other fuel costs for the Water Treatment Plant.

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

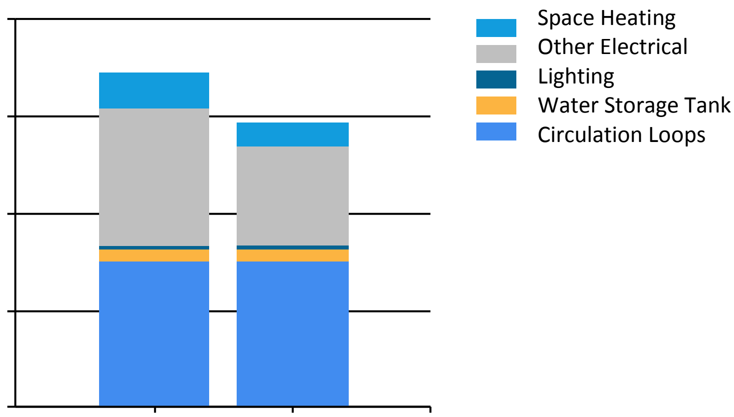


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

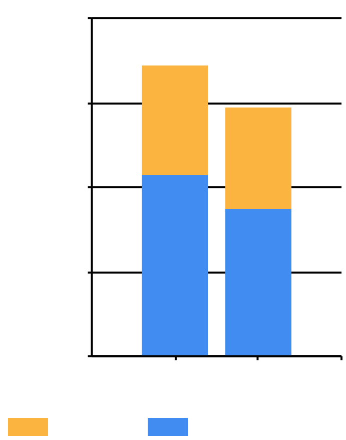
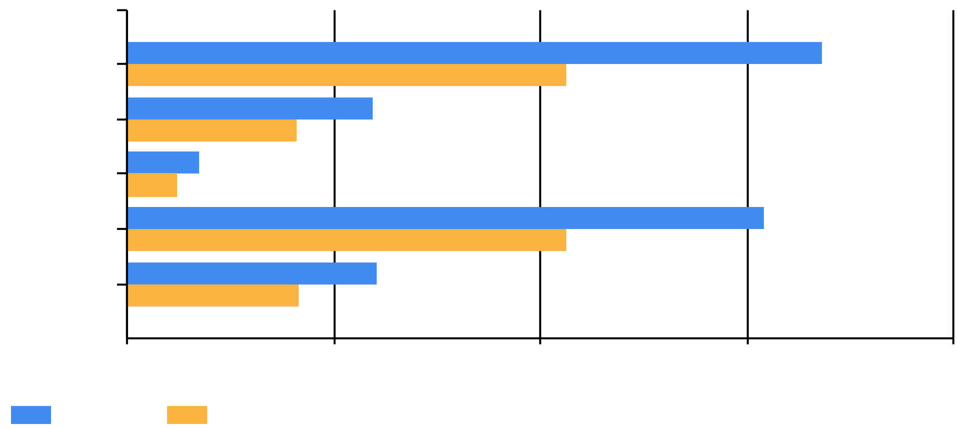


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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
Lighting	144	132	144	140	144	140	144	144	140	144	140	144
Other_Electrical	5524	5034	5524	5346	2441	2263	2338	2338	2263	3058	5346	5524
Water Storage Tank	0	0	0	0	0	0	0	0	0	0	0	0
Circulation Loops	2678	2441	2678	2592	2678	0	0	0	0	2678	2592	2678
Ventilation_Fans	0	0	0	0	0	0	0	0	0	0	0	0
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	238	216	234	222	18	11	12	12	12	68	225	238

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Water Storage Tank	23	21	23	22	23	0	0	0	0	23	22	23
Circulation Loops	165	150	165	160	165	0	0	0	0	165	160	165
DHW	0	0	0	0	0	0	0	0	0	0	0	0
Space_Heating	87	76	70	42	1	1	1	1	4	45	58	88

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):

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Fuel Oil \#1 Usage in kBtu} + \text{similar for other fuels})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu X SS Ratio} + \text{Fuel Oil Usage in kBtu X SS Ratio} + \text{similar for other fuels})}{\text{Building Square Footage}}$$

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

Table 3.4
Water Treatment Plant 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	71,221 kWh	243,079	3.340	811,883
#1 Oil	1,946 gallons	256,903	1.010	259,472
Total		**499,981**		**1,071,354**
BUILDING AREA		1,512	Square Feet	
BUILDING SITE EUI		331	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		709	**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 was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Lower Kalskag 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 Lower Kalskag. 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, Lower Kalskag, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	$363	$700	7.77	1.9
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Table 4.1 Water Treatment Plant, Lower Kalskag, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
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3	HVAC And DHW	Piping insulation to limit losses and increase efficiency. Install summer nozzles to increase burn time and limit cycling in the summer months as well as the spring and fall. By isolating the inactive boiler, jacket losses can be reduced. Excessive sooting / electrodes are burnt and need to be replaced ("retro-commissioned"). Tips needed to be replaced. Also excessive air band settings are decreasing potential efficiency.	$363	$4,200	1.67	11.6
4	Other Electrical: Heat tape to well house	Replace with Heat tape and Controls retrofit	$1,301	$5,100	1.63	3.9
5	Other Electrical: Lift Station #2 Electric Heat	Improve Manual Switching	$123	$600	1.31	4.9
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7	Other Electrical: Pressure Pumps	Replace with Goulds Pump and Improve Other Controls	$266	$2,100	1.03	7.9
	TOTAL, all measures		**$2,555**	**$13,350**	**1.84**	**5.2**

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.

4.4 Mechanical Equipment Measures

4.4.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation				
3	Retro-commission the boilers and heating system				
Installation Cost	$4,200	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$363
Breakeven Cost	$7,005	**Savings-to-Investment Ratio**	1.7	**Simple Payback yrs**	12
Auditors Notes: Piping insulation will limit losses and increase efficiency. Install summer nozzles to increase burn time and limit cycling in the spring and fall months. By isolating the inactive boiler, jacket losses can be reduced. Excessive sooting / electrodes are burnt and need to be replaced. Tips needed to be replaced. Also excessive air band settings are decreasing efficiency, and producing excessive stack air temperatures.					

4.4.2 Night Setback Thermostat Measures

Rank	Building Space			Recommendation	
1	Water Treatment Plant			Implement a Heating Temperature Unoccupied Setback to 60.0 deg F for the Water Treatment Plant space.	
Installation Cost	$700	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$363
Breakeven Cost	$5,441	**Savings-to-Investment Ratio**	7.8	**Simple Payback yrs**	2
Auditors Notes: Implementing a building setback thermostat in the water plant, so that the facility is heated to only 60 degrees when no one is in the building, as opposed to 70 degrees would significantly reduce the heating load. The monitor should already have this function built in, but a separate thermostat could be put in to control the heat through the primary boilers instead.					

4.5 Electrical & Appliance Measures

4.5.1 Other Electrical Measures

Rank	Location	Description of Existing		Efficiency Recommendation	
7	Pressure Pumps	1 Goulds Pump with Other Controls		Replace with small pressure Pump and Improve Other Controls	
Installation Cost	$2,100	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$266
Breakeven Cost	$2,153	**Savings-to-Investment Ratio**	1.0	**Simple Payback yrs**	8
Auditors Notes: Add a small high efficiency pump, and leave the two 7.5 hp for fire suppression only. The current water demand under normal usage can be provided by a much smaller pump. It is recommended that the new pump be sized for maximum pump efficiency, and be fitted with premium efficiency motor.					

Rank	Location	Description of Existing		Efficiency Recommendation	
6	Lift Station #1 Electric Heat	2 Lift Station #2 Electric Heat with Manual Switching		Improve Manual Switching	
Installation Cost	$600	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$123
Breakeven Cost	$783	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	5
Auditors Notes: Implementing a setback thermostat and setting it do 40 degrees in the wet well would save a significant amount of electrical energy. The lift stations do not need to be heated to comfortable levels as they are rarely occupied.					

Rank	Location	Description of Existing		Efficiency Recommendation	
5	Lift Station #2 Electric Heat	2 Electric Heaters in Lift Station 2 with Manual Switching		Improve Manual Switching	
Installation Cost	$600	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$123
Breakeven Cost	$783	**Savings-to-Investment Ratio**	1.3	**Simple Payback yrs**	5
Auditors Notes: Implementing a setback thermostat and setting it do 40 degrees in the wet well would save a significant amount of electrical energy. The lift stations do not need to be heated to comfortable levels as they are rarely occupied.					

Rank	Location	Description of Existing		Efficiency Recommendation	
4	Heat tape to well house	Heat tape with Manual Switching		Replace Circ pumps in lieu of heat tape use	
Installation Cost	$5,100	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$1,301
Breakeven Cost	$8,312	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	4
Auditors Notes: This retrofit requires that the circulation pumps be replaced. Pumps need to be retro commissioned. WTP personnel need training by a utility support specialist in the use of circulations pumps as the preferred options to using heat tapes for freeze protection. Currently there are 2 Grundfos UPC 50-160, 820 W circ pumps that should be used in place of heat tape. A smaller variable flow rate pump would be installed instead to minimize energy use. Budget $2500 for the pump and $2600 for training and pump installation by a utility support specialist for two days.					

Rank	Location	Description of Existing		Efficiency Recommendation	
2	Well #1 Heat tape	Heat tape with Manual Switching		Improve Manual Switching	
Installation Cost	$50	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$16
Breakeven Cost	$99	**Savings-to-Investment Ratio**	2.0	**Simple Payback yrs**	3
Auditors Notes: Well #1 is not used, heat tape is not fully operational, and should be shut off, or removed.					

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.

APPENDICES

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