Comprehensive Energy Audit
For

Akiachak Water Treatment Plant

Prepared For

Native Village of Akiachak

December 14, 2015

Prepared By:

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Table of Contents

PREFACE

This energy audit was conducted using funds from the United States Department of Agriculture Rural Utilities Service as well as the State of Alaska Department of Environmental Conservation. Coordination with the State of Alaska Remote Maintenance Worker (RMW) Program and the associated RMW for each community has been undertaken to provide maximum accuracy in identifying audits and coordinating potential follow up retrofit activities.

The Energy Projects Group at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for The Akiachak Native Community, Alaska. The authors of this report are Carl Remley, Certified Energy Manager (CEM); and Kevin Ulrich, Energy Manager-in-Training (EMIT).

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in September of 2015 by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operators Henry Positnik and Ronald Nose, Remote Maintenance Worker Bob White, Akiachak Tribal Administrator Jonathan Lomack, and Akiachak Business Manager Mildred Evans.

1. EXECUTIVE SUMMARY

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

In the near future, a representative of ANTHC will be contacting both the Akiachak Native Community and the water treatment plant operators to follow up on the recommendations made in this audit report. Funding has been provided to the ANTHC through a Rural Alaska Village Grant and the Denali Commission to provide the Akiachak Native Community with assistance in understanding the report.

The total predicted energy cost for the Akiachak Water Treatment Plant is $91,894 per year. Electricity represents the largest portion with an annual cost of $60,861. This includes $25,359 paid by the community and $35,502 paid by the Power Cost Equalization (PCE) program through the State of Alaska. Fuel oil represents the remaining portion with an annual cost of $30, 707. The building is supplied with recovered heat from the neighboring power plant at zero charge. For the purpose of the energy modeling, $325 per year is considered for maintenance purposes.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower the electricity costs and make energy affordable in rural Alaska. In Akiachak, the cost of electricity without PCE is $0.60/KWH and the cost of electricity with PCE is $0.25/KWH.

There is a heat recovery system that transfers recovered heat from the generator cooling loop in the power plant to the water treatment plant. This system was constructed in 2005. The heat recovery system provides heating for all the heating loads in the water treatment plant and covers a large portion of the heating load on an annual basis. During the site visit, it was observed that while the heat recovery system was in operation there was heat also being rejected into the atmosphere through the power plant radiators. Upon inspection, it was determined that the pump and heat exchanger for the heat recovery loop in the water treatment plant are undersized and incapable of transferring all the heat provided by the power plant. This issue is detailed later in this report.

The Akiachak Water Treatment Plant has a generator located in a separate building on the building property. The generator is intended for use as a backup generator in the event that the community electricity is not available. The operators currently run the water plant generators during the daytime when the electric demand for the facility is high. Over a two year period the water treatment plant has used approximately 8,988.7 gallons of diesel fuel for the onsite generator. Assuming that 30% of the fuel used in the generator is converted into useable electricity, the two-year fuel usage is converted to an equivalent electricity production of approximately 52,952 kWh per year. Because this electricity is not produced by an electric utility, this production is not eligible for a PCE subsidy, which means that the cost of electricity produced by the water treatment plant is $0.60/kWh for a total of approximately $31,771 annually. If the water treatment plant were to receive the equivalent electricity production from the community power plant, it could benefit from the PCE subsidy already given to the power plant and receive electricity at a rate of $0.25/kWh. The total cost of this electricity would be approximately $13,238 annually. The total savings of eliminating the daytime use of the onsite generators and receiving the equivalent power from the local power plant is approximately $18,533 annually. This could also increase the potential benefits of the existing heat recovery system between the power plant and the water treatment plant. ANTHC is willing to help the community make the necessary adjustments to maximize the benefit of the PCE subsidy through minimizing the use of the onsite generator.

The table below lists the total usage of electricity, #1 oil, and recovered heat in the water treatment plant before and after the proposed retrofits.

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	101,436 kWh	88,403 kWh
#1 Oil	10,168 gallons	3,881 gallons
Heat Recovery	324.82 million Btu	352.24 million Btu

Benchmark figures facilitate comparing energy use between different buildings. The table below lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	434.1	32.85	$19.81
With Proposed Retrofits	251.4	19.03	$14.04
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.1 below summarizes the energy efficiency measures analyzed for the Akiachak 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]	CO_2 Savings
1	Other Electrical - Circulation Pump 2 Loop B	Shut off circulation pumps during the summer months.	$3,335	$2,000	10.32	0.6	10,559.5
2	Lighting - Exterior Lighting 250 Watt	Replace with new energy-efficient LED lighting.	$957	$1,500	9.32	1.6	3,030.8
3	Heat Add Controls	Repair heat add temperature controls and shut off raw water heat add in summer.	$8,580	$20,000	5.81	2.3	64,464.1
4	Other Electrical - Circulation Pump 1 Loop A	Shut off circulation pumps during the summer months.	$1,335	$2,000	5.62	1.5	4,226.5

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]	CO_2 Savings
5	Lighting - Garage High Bay 400	Replace with new energy-efficient LED lighting.	$419	$1,600	3.75	3.8	1,149.8
6	Lighting - Exterior Lighting 70 Watt	Replace with new energy-efficient LED lighting.	$301	$1,200	3.66	4.0	951.8
7	Lighting - WTP Lower and Second Floor	Replace with new energy-efficient LED lighting.	$133	$640	2.97	4.8	359.0
8	Heating, Ventilation, and Domestic Hot Water	Maximize use of heat recovery system by increasing pumps and heat exchangers to use all available heat from generators and improve controls as necessary. Also shut off boilers during summer months.	$9,342	$60,000	2.71	6.4	53,511.8
9	Lighting - WTP High Bay	Replace with new energy-efficient LED lighting.	$713	$4,000	2.59	5.6	2,049.5
10	Lighting -: Office	Replace with new energy-efficient LED lighting.	$53	$320	2.43	6.0	153.7
11	Lighting - Garage Task Lighting	Replace with new energy-efficient LED lighting.	$90	$640	2.04	7.1	258.3
12	Lighting - Garage High Bay 250	Replace with new energy-efficient LED lighting.	$100	$800	1.81	8.0	286.9
13	Heat Add Controls	Repair circulation heat add controls on both loops.	$773	$10,000	1.04	12.9	8,254.6
14	Heat Add Controls	Repair tank heat add controls and shut off tank heat add in summer.	$399	$6,000	0.90	15.0	4,267.4
15	Lighting - Boiler Room	Replace with new energy-efficient LED lighting.	$24	$480	0.73	20.0	69.2
16	Air Tightening: Garage Doors	Improve sealing around garage doors, especially at the sides and bottom.	$220	$3,000	0.67	13.6	2,345.4
17	Lighting - Rest Rooms & Third Floor Isle	Replace with new energy-efficient LED lighting.	$8	$480	0.24	59.9	23.2
	TOTAL, all measures		**$26,780**	**$114,660**	**3.22**	**4.3**	**155,961.5**

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 $26,780 per year, or 29.1% of the buildings' total energy costs. These measures are estimated to cost $114,660, for an overall simple payback period of 4.3 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**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Water Circulation Heat**	**Tank Heat**	**Total Cost**
Existing Building	$26,117	$559	$131	$5,039	$35,422	$17,903	$4,222	$2,500	**$91,894**
With Proposed Retrofits	$23,135	$995	$131	$2,147	$30,753	$4,359	$1,744	$1,849	**$65,113**
Savings	$2,982	-$436	$0	$2,892	$4,669	$13,544	$2,478	$650	**$26,780**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Akiachak Water Treatment Plant. The scope of this project included evaluating building shell, lighting and other electrical systems, and heating and ventilation 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 and ventilation equipment
- 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 the Akiachak 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.

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

1) Water Treatment Plant: 4,638 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; heating and ventilation; 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. Akiachak Water Treatment Plant

3.1. Building Description

The 4,638 square foot Akiachak Water Treatment Plant was constructed in 1990, with a normal occupancy of 1 person. The number of hours of operation for this building average 5 hours per day, considering all seven days of the week.

The Akiachak Water Treatment Plant serves as the water distribution center for the residents of the community and houses all the components for two active distribution loops. A third loop is going to be installed when the town completes the remaining portion of the water and sewer project. A large garage area is also located in the water treatment plant.

The Akiachak Water Treatment Plant has two distribution loops that are used to provide water service to the western side of the community. The two loops combine to serve all the residential and public facilities with distributed water and they are a combined 9000 ft. long approximately. The eastern side of the community does not have piped water. The water treatment plant was built with the capacity to handle a third loop for the eastern side of town. Construction on a new water distribution loop for the eastern side of town will begin in summer 2016. The construction of the new water loop adds to the importance of energy efficiency because the additional operations could further increase inefficiencies and operational deficiencies that may exist because of the increased energy demand.

Water is pumped into the water treatment plant from a well approximately 200 feet from the building. The water is pumped through an open-air filtration system with a large mixing tank for chemical injection of soda ash, lime, and chlorine. The water is injected with the chemicals and mixed before being sent to the 318,000 gallon water storage tank.

<u>Description of Building Shell</u>

The exterior walls are constructed with stressed skin panels that are six inches thick. The panels have five inches of polyurethane foam insulation that is slightly damaged and there is approximately 7,175 square feet of wall space in the building.

The building has a cathedral ceiling with standard framing and 24-inch spacing. The roof has six inches of polyurethane foam insulation that is slightly damaged and there is approximately 4,782 square feet of roof space in the building.

The building is built on grade with a slab foundation. The foundation has four inches of XPS blue foam board throughout the entire floor area and there are approximately 4,638 square feet of floor space in the building.

There are four windows in the building, each of which is wood-framed and double-paned. There is a total of 52 square feet of window space in the building.

There are four exterior doors in the building. Each of the doors is metal with an insulated core and there is a total of approximately 84 square feet of door space in the building. There are also three large metal garage doors in the garage portion of the building. These doors are uninsulated and are not sealed properly on the sides or bottom. There is a total of approximately 456 square feet of garage door space in the building.

Description of Heating Plants

The Heating Plants used in the building are:

BP 1 Weil McLean
Nameplate Information: BL 1088 WF Boiler 21.5 GPH Firing Rate with Beckett CF 2500 -W Burner with high-low controls.
Fuel Type: #1 Oil
Input Rating: 2,132,000 BTU/hr
Steady State Efficiency: 78 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year

BP 2 Weil McLean
Nameplate Information: Weil McLean BL 1088 WF Boiler with Beckett CF 2500-W Burner with high low controls
Fuel Type: #1 Oil
Input Rating: 2,132,000 BTU/hr
Steady State Efficiency: 78 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year

Heat Recovery System
Fuel Type: Heat Recovery
Input Rating: 998,000 BTU/hr
Steady State Efficiency: 99 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year

Space Heating Distribution Systems

There are seven unit heaters in the building that are used to provide space heat in the occupied zones. All of the unit heaters are Dunham-Bush models that combine to produce approximately 400,000 BTU/hr of heating.

There are five pumps associated with the heating distribution processes. Two pumps, CP-4A and CP-4B, circulate heated glycol to the raw water heat-add heat exchanger at a rate of 150 GPM. Two pumps, CP-5A and CP-5B, circulate heated glycol to all the unit heaters and five heat-add heat exchangers. One pump, CP-6, circulates glycol through the heat recovery heat exchanger. It should be noted that CP-6 is a Grundfos Series L Model TP 100-80 that is operating at a maximum rating of 285 Watts. This pump is not the same pump indicated in the heat recovery specifications.

Domestic Hot Water System

There are two hot water heaters that are used for hot water purposes in the bathroom, shower, and utility sink. The two heaters are Amtrol Model WH-7C-DW with a 41 gallon storage capacity for each tank. The domestic hot water system uses an estimated 5 gallons of water per day. Included with the heaters is a small pump, CP-7, that is a Grundfos Model UP15-18BUC7 rated for 85 Watts. The pump operates whenever there is a call for hot water.

Heat Recovery Information

There is a heat recovery system that transfers heat from the generator cooling loop in the power plant to the water treatment plant that heats the glycol before going into the boilers. The system produces an average of 998,000 BTU/hr during the winter season and covers a significant portion of the water treatment plant heating load. When the heat recovery system is in full operation, the power plant is still releasing heat through the radiators because the heat recovery system does not have the capacity to transfer heat quick enough for effective generator cooling. Approximately 150,000 BTU/hr is being transferred through the power plant radiators. The winter power plant load is approximately 300-400 kW on average.

Description of Building Ventilation System

There are exhaust fans present in the two rest rooms that operate when the rest room lights are turned on. The fan in one room operates at 50 Watts and produces 72 CFM while the fan in the second room operates at 50 Watts and produces 84 CFM. The rest room use is approximately 30 minutes per day.

There is an exhaust fan present in the office that operates during normal operator hours. The fan operates at 100 Watts and produces 380 CFM. The usage is approximately 5 hours per day.

There is a large exhaust fan in the storage area that operates for approximately 15 minutes per day when the room is occupied by an operator. The fan operates at 298 Watts and produces 3,730 CFM.

Lighting

The main water treatment plant space has 10 high bay 250 Watt metal halide lights. These lights operate approximately five hours per day when the operators are working and consume approximately 2,554 kWh annually.

The garage has 4 high bay 400 Watt metal halide lights. These lights operate approximately 3.5 hours per day when the garage is occupied and consume approximately 1,141 kWh annually.

The garage has 2 high bay 250 Watt metal halide lights. These lights operate approximately 3.5 hours per day when the garage is occupied and consume approximately 358 kWh annually.

There are eight fixtures with two T8 4-ft. light bulbs in each fixture that are used for task lighting in the garage space. The lights operate approximately 3.5 hours per day when the garage is occupied and consume approximately 530 kWh annually.

The first and second levels of the water treatment plant space have eight fixtures with two T8 4-ft. fluorescent light bulbs in each fixture. These lights operate approximately five hours per day when the operators are working and consume approximately 841 kWh annually.

The office has four fixtures with two T8 4-ft. fluorescent light bulbs in each fixture. The lights operate approximately five hours per day when the operators are working and consume approximately 315 kWh annually.

The boiler room has six fixtures with two T8 4-ft. fluorescent light bulbs in each fixture. The lights operate approximately 1.5 hours per day and consume approximately 142 kWh annually.

The third floor area has six fixtures with two T8 4-ft. fluorescent light bulbs in each fixture. The lights operate approximately 30 minutes per day and consume approximately 47 kWh annually.

The exterior of the building has three 250 Watt high pressure sodium lights that operate constantly from September to April. These lights consume approximately 1,790 kWh annually. The exterior of the building also has four fixtures with a single 70 Watt light bulb in each fixture. These lights operate constantly from September to April and consume approximately 682 kWh annually.

Plug Loads

The water treatment plant has a variety of power tools, a telephone, and some other miscellaneous loads that require a plug into an electrical outlet. The use of these items is infrequent and consumes a small portion of the total energy demand of the building.

Major Equipment

There are two circulation pumps on Loop A that are used to circulate water through the Loop A distribution loop to residents of the community. The pumps are rated for 1.5 HP and one of the pumps operates constantly all year long. The pumps consume approximately 8,898 kWh annually.

There are two circulation pumps on Loop B that are used to circulate water through the Loop B distribution loop to residents of the community. The pumps are rated for 3.5 HP and one of the pumps operates constantly all year long. The pumps consume approximately 22,231 kWh annually.

There is a well pump that is used to pump water from the raw water intake well to the water treatment plant. The pump is rated for 6.8 HP and operates approximately seven hours per day all year long. The pump consumes approximately 12,970 kWh annually.

There are three pressure pumps that are used to maintain the necessary pressure for the operations of the water distribution system. The pumps are rated for 10 HP and operate 14% of the time all year long. The pumps consume approximately 9,338 kWh annually.

There is a clarifier pump that is used to circulate the treated water through the clarifier. The pump is rated for 253 Watts and operates constantly all year long. The pump consumes approximately 2,218 kWh annually.

There is a backwash pump that is used to backwash the treatment system for general maintenance purposes. The pump is rated for 3,805 Watts and operates approximately 20 minutes per day all year long. The pump consumes approximately 397 kWh annually.

There is an air compressor that is used for a variety of maintenance and repair tasks in the water treatment plant and the garage. The compressor is rated for 320 Watts and is estimated to operate approximately 3% of the time all year long. The compressor consumes approximately 84 kWh annually.

There is a lift station pump that is used to collect the sewage from the resident houses and pump it to a sewage lagoon. The pump is rated for 6.8 HP and operates approximately 4% of the time all year long. The pump consumes approximately 1,779 kWh annually.

There are a variety of miscellaneous pumps and controls in the water treatment plant associated with the general operations of the water treatment plant. The equipment is estimated to use approximately 1,122 kWh annually.

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 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 Akiachak Native Community Electricity Company provides electricity to the residents of Akiachak as well as all the commercial and public facilities.

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	$ 0.60/kWh
#1 Oil	$ 3.02/gallons
Heat Recovery	$ 1.00/million Btu

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, WTP pays approximately $91,894 annually for electricity and other fuel costs for the Akiachak 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

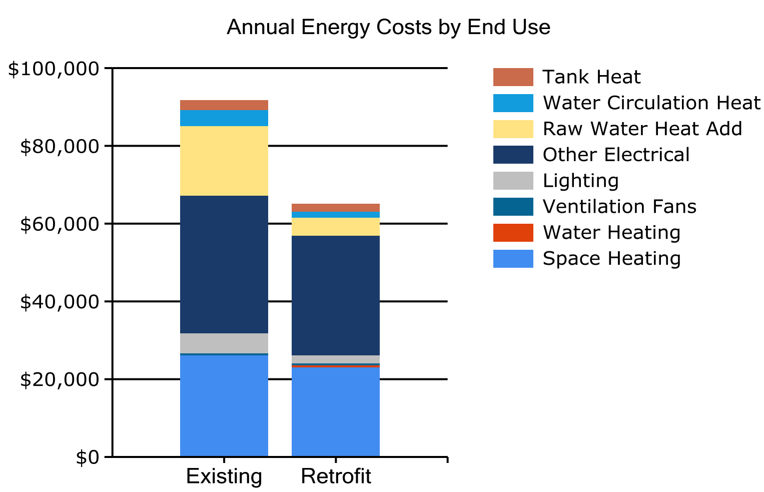


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

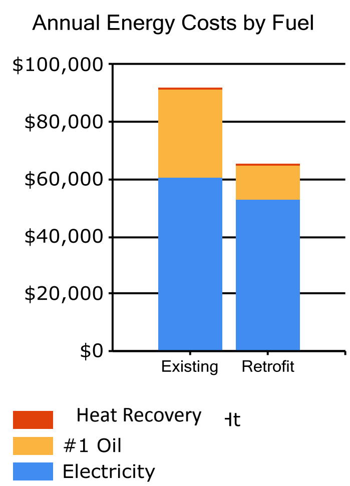
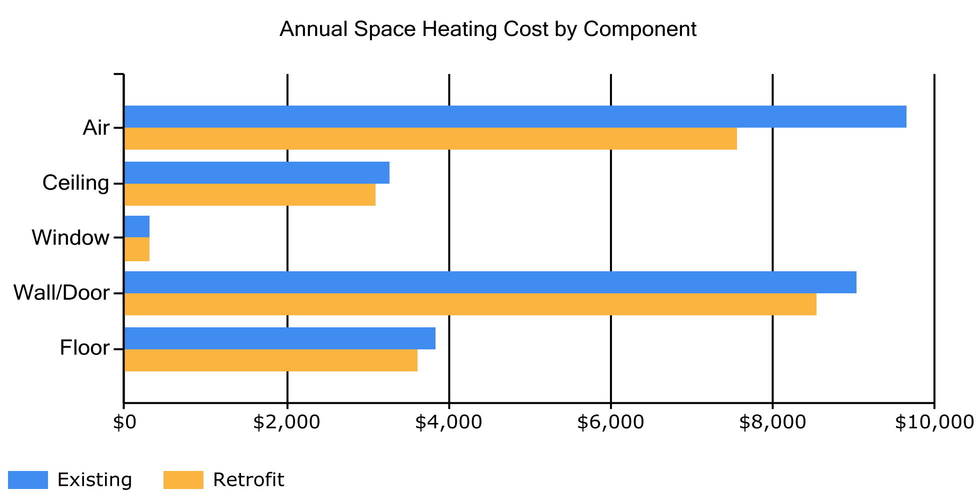


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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
Space Heating	2821	2568	2802	2681	2734	2630	2712	2715	2639	2760	2700	2821
DHW	63	58	63	61	63	61	63	63	61	63	61	63
Ventilation Fans	19	17	19	18	19	18	19	19	18	19	18	19
Lighting	862	786	862	661	503	487	503	503	672	862	835	862
Other Electrical	5011	4566	5011	4849	5011	4849	5011	5011	4849	5011	4849	5011
Raw Water Heat Add	25	23	26	26	30	29	31	31	29	28	25	25
Water Circulation Heat	6	5	6	6	7	7	7	7	7	7	6	6
Tank Heat	7	6	7	5	2	1	0	0	2	4	5	7

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	419	371	337	176	29	0	0	0	0	129	272	421
DHW	3	2	3	3	3	3	4	4	3	3	3	3
Raw Water Heat Add	420	385	437	467	536	539	562	560	532	503	439	420
Water Circulation Heat	99	91	103	110	126	127	133	132	126	119	103	99
Tank Heat	122	110	112	85	44	12	0	5	29	73	95	122

Recovered Heat Consumption (Million Btu)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space Heating	12	11	10	4	0	0	0	0	0	3	7	12
Raw Water Heat Add	14	13	15	15	18	18	18	18	17	17	15	14
Water Circulation Heat	3	3	3	4	4	4	4	4	4	4	3	3
Tank Heat	4	4	4	3	1	0	0	0	1	2	3	4

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):

$$\textit{Building Site EUI} = \frac{(\textit{Electric Usage in kBtu} + \textit{Fuel Oil Usage in kBtu})}{\textit{Building Square Footage}}$$

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
Akiachak 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	101,436 kWh	346,200	3.340	1,156,307
#1 Oil	10,168 gallons	1,342,180	1.010	1,355,601
Heat Recovery	324.82 million Btu	324,823	1.280	415,773
Total		**2,013,202**		**2,927,681**
BUILDING AREA		4,638	Square Feet	
BUILDING SITE EUI		434	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		631	**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.				

Table 3.5

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	434.1	32.85	$19.81
With Proposed Retrofits	251.4	19.03	$14.04
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

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 heating and ventilation systems 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 Akiachak Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Akiachak 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 Akiachak. 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 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 heating loads across different parts of the building.

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.

Table 4.1 Akiachak Water Treatment Plant, Akiachak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
1	Other Electrical - Circulation Pump 2 Loop B	Shut off circulation pumps during the summer months.	$3,335	$2,000	10.32	0.6	10,559.5
2	Lighting - Exterior Lighting 250 Watt	Replace with new energy-efficient LED lighting.	$957	$1,500	9.32	1.6	3,030.8
3	Heat Add Controls	Repair heat add temperature controls and shut off raw water heat add in summer.	$8,580	$20,000	5.81	2.3	64,464.1
4	Other Electrical - Circulation Pump 1 Loop A	Shut off circulation pumps during the summer months.	$1,335	$2,000	5.62	1.5	4,226.5
5	Lighting - Garage High Bay 400	Replace with new energy-efficient LED lighting.	$419	$1,600	3.75	3.8	1,149.8

Table 4.1 Akiachak Water Treatment Plant, Akiachak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
6	Lighting - Exterior Lighting 70 Watt	Replace with new energy-efficient LED lighting.	$301	$1,200	3.66	4.0	951.8
7	Lighting - WTP Lower and Second Floor	Replace with new energy-efficient LED lighting.	$133	$640	2.97	4.8	359.0
8	Heating, Ventilation, and Domestic Hot Water	Maximize use of heat recovery system by increasing pumps and heat exchangers to use all available heat from generators and improve controls as necessary. Also shut off boilers during summer months.	$9,342	$60,000	2.71	6.4	53,511.8
9	Lighting - WTP High Bay	Replace with new energy-efficient LED lighting.	$713	$4,000	2.59	5.6	2,049.5
10	Lighting -: Office	Replace with new energy-efficient LED lighting.	$53	$320	2.43	6.0	153.7
11	Lighting - Garage Task Lighting	Replace with new energy-efficient LED lighting.	$90	$640	2.04	7.1	258.3
12	Lighting - Garage High Bay 250	Replace with new energy-efficient LED lighting.	$100	$800	1.81	8.0	286.9
13	Heat Add Controls	Repair circulation heat add controls on both loops.	$773	$10,000	1.04	12.9	8,254.6
14	Heat Add Controls	Repair tank heat add controls and shut off tank heat add in summer.	$399	$6,000	0.90	15.0	4,267.4
15	Lighting - Boiler Room	Replace with new energy-efficient LED lighting.	$24	$480	0.73	20.0	69.2
16	Air Tightening: Garage Doors	Improve sealing around garage doors, especially at the sides and bottom.	$220	$3,000	0.67	13.6	2,345.4
17	Lighting - Rest Rooms & Third Floor Isle	Replace with new energy-efficient LED lighting.	$8	$480	0.24	59.9	23.2
	TOTAL, all measures		**$26,780**	**$114,660**	**3.22**	**4.3**	**155,961.5**

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. Lighting-efficiency improvements are anticipated to slightly increase heating requirements. Heating penalties were included in the lighting project analysis.

4.3 Building Shell Measures

4.3.1 Air Sealing Measures

Rank	Location		Existing Air Leakage Level (cfm@50/75 Pa)		Recommended Air Leakage Reduction (cfm@50/75 Pa)	
16	Garage Doors		Air Tightness estimated as: 3000 cfm at 50 Pascals		Improve sealing around garage doors, especially at the sides and bottom.	
Installation Cost		$3,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$220
Breakeven Cost		$2,016	**Savings-to-Investment Ratio**	0.7	**Simple Payback yrs**	14
Auditors Notes: There are large spaces around the sides and bottom of the garage door that appear because the door does not fully close and cover the open space in the wall. The bottom of the door could have a simple rug or skirt attached while the side could be covered by an insulation layer to stop the air penetration.						

4.4 Mechanical Equipment Measures

4.4.1 Heating/ Domestic Hot Water Measure

Rank	Recommendation					
8	Maximize use of heat recovery system by increasing pumps and heat exchangers to use all available heat from generators and improve controls as necessary. Also shut off boilers during summer months.					
Installation Cost		$60,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$9,342
Breakeven Cost		$162,593	**Savings-to-Investment Ratio**	2.7	**Simple Payback yrs**	6
Auditors Notes: The heat recovery system does not operate at full capacity as there is heat actively being released by the power plant radiators despite the heat recovery system operating fully. The pump and heat exchanger in the water plant should be resized and the piping changed for a larger diameter to accommodate more heat and allow the heat recovery system to be maximized.						

4.5 Electrical & Appliance Measures

4.5.1 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 loads. The building heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation
2	Exterior Lighting 250 Watt	3 HPS 250 Watt StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$957
Breakeven Cost	$13,983	**Savings-to-Investment Ratio**	9.3	**Simple Payback yrs**	2

Auditors Notes: Replace existing HPS light fixtures with LED fixtures with five 25 Watt LED light bulbs. The exterior has 3 fixtures with five bulbs per fixture to be added for a total of 15 new light bulbs.

Rank	Location	Existing Condition	Recommendation
5	Garage High Bay 400	4 MH 400 Watt StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$1,600	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$419
Breakeven Cost	$6,004	**Savings-to-Investment Ratio**	3.8	**Simple Payback yrs**	4

Auditors Notes: Replace existing metal halide light fixtures with LED fixtures with five 25 Watt LED light bulbs. This room has 4 fixtures with five bulbs per fixture to be added for a total of 20 new light bulbs.

Rank	Location	Existing Condition	Recommendation
6	Exterior Lighting 70 Watt	4 HPS 70 Watt StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$1,200	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$301
Breakeven Cost	$4,392	**Savings-to-Investment Ratio**	3.7	**Simple Payback yrs**	4

Auditors Notes: Replace existing HPS light fixtures with LED fixtures with 17 Watt LED equivalents. The exterior has 4 fixtures to be added for a total of 4 new light bulbs.

Rank	Location	Existing Condition	Recommendation
7	WTP lower and second floor	8 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$640	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$133
Breakeven Cost	$1,898	**Savings-to-Investment Ratio**	3.0	**Simple Payback yrs**	5

Auditors Notes: Replace existing fluorescent light fixtures with 17 Watt 4-ft. LED equivalents. This room has 8 fixtures with two bulbs per fixture for a total of 16 light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
9	WTP High Bay	10 MH 250 Watt StdElectronic with Manual Switching	Replace with new energy-efficient LED lighting.

Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$713
Breakeven Cost	$10,351	**Savings-to-Investment Ratio**	2.6	**Simple Payback yrs**	6

Auditors Notes: Replace existing metal halide light fixtures with LED fixtures with five 25 Watt LED light bulbs. This room has 10 fixtures with five bulbs per fixture to be added for a total of 50 new light bulbs.

Rank	Location	Existing Condition	Recommendation
10	Office	4 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching, Occupancy Sensor	Replace with new energy-efficient LED lighting.

Installation Cost	$320	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$53
Breakeven Cost	$777	**Savings-to-Investment Ratio**	2.4	**Simple Payback yrs**	6

Auditors Notes: Replace existing fluorescent light fixtures with 17 Watt 4-ft. LED equivalents. This room has 4 fixtures with two bulbs per fixture for a total of 8 light bulbs to be replaced.

Rank	Location	Existing Condition		Recommendation	
11	Garage Task Lighting	8 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting.	
Installation Cost	$640	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$90
Breakeven Cost	$1,305	**Savings-to-Investment Ratio**	2.0	**Simple Payback yrs**	7
Auditors Notes: Replace existing fluorescent light fixtures with 17 Watt 4-ft. LED equivalents. This room has 8 fixtures with two bulbs per fixture for a total of 16 light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
12	Garage High Bay 250	2 MH 250 Watt StdElectronic with Manual Switching		Replace with new energy-efficient LED lighting.	
Installation Cost	$800	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$100
Breakeven Cost	$1,449	**Savings-to-Investment Ratio**	1.8	**Simple Payback yrs**	8
Auditors Notes: Replace existing metal halide light fixtures with LED fixtures with five 25 Watt LED light bulbs. This room has 2 fixtures with five bulbs per fixture to be added for a total of 10 new light bulbs.					

Rank	Location	Existing Condition		Recommendation	
15	Boiler Room	6 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching, Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost	$480	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$24
Breakeven Cost	$349	**Savings-to-Investment Ratio**	0.7	**Simple Payback yrs**	20
Auditors Notes: Replace existing fluorescent light fixtures with 17 Watt 4-ft. LED equivalents. This room has 6 fixtures with two bulbs per fixture for a total of 12 light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
17	Rest Rooms & Third Floor Isle	6 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching, Occupancy Sensor		Replace with new energy-efficient LED lighting.	
Installation Cost	$480	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$8
Breakeven Cost	$116	**Savings-to-Investment Ratio**	0.2	**Simple Payback yrs**	60
Auditors Notes: Replace existing fluorescent light fixtures with 17 Watt 4-ft. LED equivalents. This room has 6fixtures with two bulbs per fixture for a total of 12 light bulbs to be replaced.					

4.5.2 Other Electrical Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
1	Circulation Pump 2 Loop B		Circulation Pump with Manual Switching		Shut off circulation pumps during the summer months.	
Installation Cost		$2,000	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$3,335
Breakeven Cost		$20,642	**Savings-to-Investment Ratio**	10.3	**Simple Payback yrs**	1
Auditors Notes: Shut off circulation pump during summer months.						

Rank	Location		Description of Existing		Efficiency Recommendation	
4	Circulation Pump 1 Loop A		Circulation Pump with Manual Switching		Shut off circulation pumps during the summer months.	
Installation Cost		$2,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$1,335
Breakeven Cost		$11,239	**Savings-to-Investment Ratio**	5.6	**Simple Payback yrs**	1
Auditors Notes: Shut off circulation pump during summer months.						

4.5.3 Other Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
3	Raw Water Heat Add		Raw Water Heat Add Load		Repair heat add temperature controls and shut off raw water heat add in summer.	
Installation Cost		$20,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$8,580
Breakeven Cost		$116,156	**Savings-to-Investment Ratio**	5.8	**Simple Payback yrs**	2
Auditors Notes: The existing controls do not function and as a result there is a constant call for heat to the raw water heat add loop at all times throughout the year. This recommendation is to repair or replace the controls for the raw water heat add loop, set the heat add temperature to 40 deg. F, and shut off the raw water heat add in the summer months when there is no concern about potential freeze-ups.						

Rank	Location		Description of Existing		Efficiency Recommendation	
13	Water Circulation Loops		Water Circulation Heat Load		Repair circulation heat add controls on both loops.	
Installation Cost		$10,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$773
Breakeven Cost		$10,443	**Savings-to-Investment Ratio**	1.0	**Simple Payback yrs**	13
Auditors Notes: The existing controls do not function and as a result there is a constant call for heat to the water circulation loops. This recommendation is to repair or replace the controls for the heat-add on the water circulation loops and set the distribution temperature to 40 deg. F.						

Rank	Location		Description of Existing		Efficiency Recommendation	
14	Water Storage Tank		Tank Heat Load		Repair tank heat add controls and shut off tank heat add in summer.	
Installation Cost		$6,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$399
Breakeven Cost		$5,394	**Savings-to-Investment Ratio**	0.9	**Simple Payback yrs**	15
Auditors Notes: The existing controls do not function and as a result there is a constant call for heat to the water storage tank. This recommendation is to repair or replace the controls for the heat-add on the water storage tank and set the storage temperature to 40 deg. F.						

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.

In the near future, a representative of ANTHC will be contacting both the Akiachak Native Community and the water treatment plant operator to follow up on the recommendations made in this audit report. Funding has been provided to ANTHC through a Rural Alaska Village Grant and the Denali Commission to provide the Akiachak Native Community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Akiachak Water Treatment Plant	**Auditor Company:** ANTHC-DEHE
Address: P O Box 51070	**Auditor Name:** Carl Remley and Kevin Ulrich
City: Akiachak	**Auditor Address:** 3900 Ambassador Drive Anchorage, AK 99508
Client Name: Henry Positnik and Ronald Nose	
Client Address: P O Box 51070 Akiachak, AK 99551	**Auditor Phone:** (907) 729-3237
	Auditor FAX:
Client Phone: (907) 825-2028	**Auditor Comment:** Phone number and email is for Kevin
Client FAX:	
Design Data	
Building Area: 4,638 square feet	**Design Space Heating Load:** Design Loss at Space: 345,111 Btu/hour with Distribution Losses: 383,457 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 584,537 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 70 deg F (building average)
Actual City: Akiachak	**Design Outdoor Temperature:** -39 deg F
Weather/Fuel City: Akiachak	**Heating Degree Days:** 13,213 deg F-days
Utility Information	
Electric Utility: Akiachak Commercial - Sm	**Average Annual Cost/kWh:** $0.600/kWh

Annual Energy Cost Estimate									
Description	**Space Heating**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Raw Water Heat Add**	**Water Circulation Heat**	**Tank Heat**	**Total Cost**
Existing Building	$26,117	$559	$131	$5,039	$35,422	$17,903	$4,222	$2,500	**$91,894**
With Proposed Retrofits	$23,135	$995	$131	$2,147	$30,753	$4,359	$1,744	$1,849	**$65,113**
Savings	$2,982	-$436	$0	$2,892	$4,669	$13,544	$2,478	$650	**$26,780**

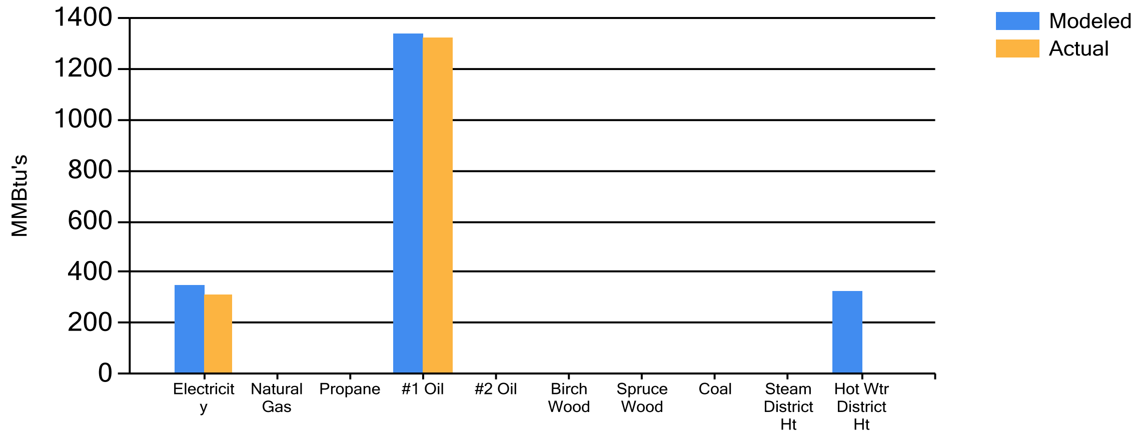
Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	434.1	32.85	$19.81
With Proposed Retrofits	251.4	19.03	$14.04

EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.
EUI/HDD: Energy Use Intensity per Heating Degree Day.
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.

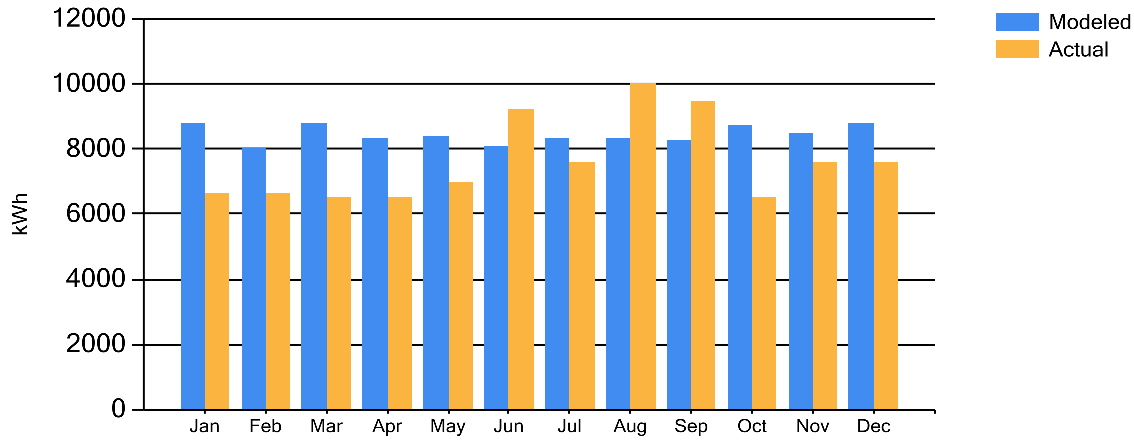
Appendix B – Actual Fuel Use versus Modeled Fuel Use

The Orange bars show Actual fuel use, and the Blue bars are AkWarm's prediction of fuel use.

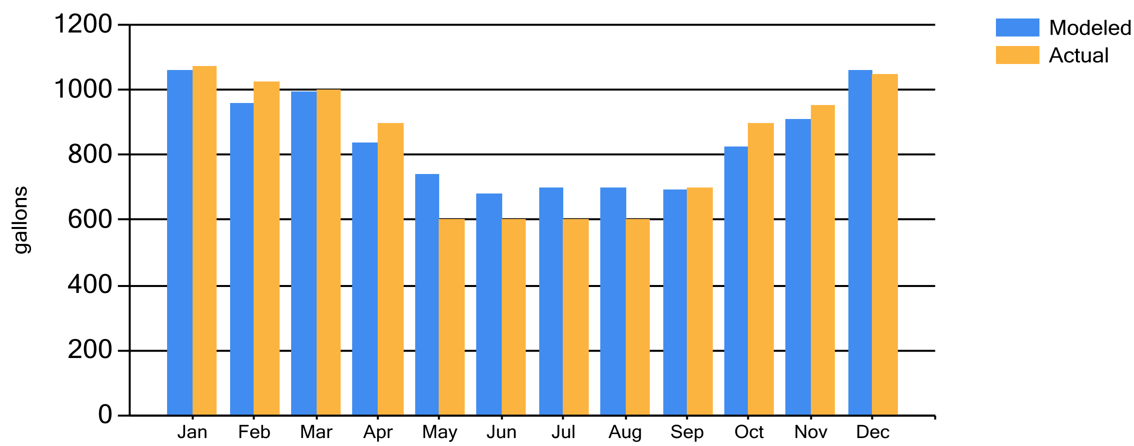
Annual Fuel Use



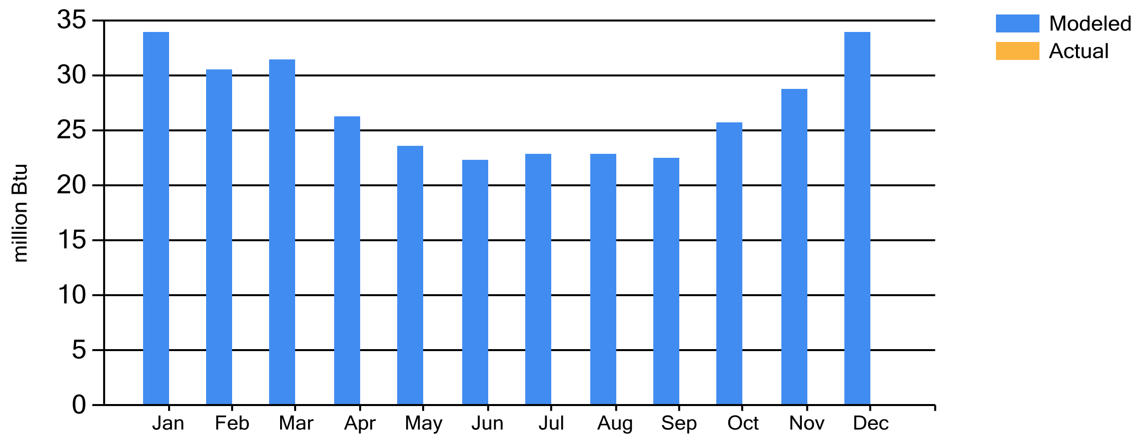
Electricity Fuel Use



#1 Fuel Oil Fuel Use



Recovered Heat Fuel Use


million Btu
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Modeled
Actual

Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Current	20.4	20.4	20.4	20.4	20.3	20.3	20.3	20.3	20.3	20.3	20.4	20.4
As Proposed	17.8	17.8	17.8	17.7	17.7	17.6	17.6	17.6	17.7	17.7	17.7	17.8

AkWarmCalc Ver 2.4.1.0, Energy Lib 3/30/2015