



Comprehensive Energy Audit For Stebbins Old Water Treatment Plant



Prepared For
City of Stebbins

June 15, 2015

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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 City of Stebbins, Alaska. The authors of this report are Carl Remley, Certified Energy Auditor (CEA) and 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 April 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. Please note that this report is for the Stebbins Old Water Plant only. A separate report covers the Stebbins Washeteria.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operator Peter Martin and Stebbins City Administrator Nora Tom.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Stebbins. The scope of the audit focused on Stebbins Old 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 City of Stebbins 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 city with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2015 calendar year.

The total predicted energy cost for the Stebbins Old Water Treatment Plant is \$18,458 per year. Electricity represents the largest portion with an annual cost of \$9,893. This includes \$3,805 paid by the City and \$6,088 paid by the Power Cost Equalization (PCE) program through the State of Alaska. Fuel oil represents the remaining portion of the building energy consumption with an annual cost of \$8,565. These predictions are based on the electricity and fuel prices at the time of the audit.

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 Stebbins, the cost of electricity without PCE is \$0.52/KWH and the cost of electricity with PCE is \$0.20/KWH.

The Stebbins Old Water Treatment Plant received funding from the Renewable Energy Fund managed by the Alaska Energy Authority to implement a heat recovery system from the new power plant to the new water plant, washeteria, old water plant, clinic, and school buildings. The projected savings for this project for the Stebbins Old Water Treatment Plant are reflected in this report.

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

Predicted Annual Fuel Use		
Fuel Use	Existing Building	With Proposed Retrofits
Electricity	17,513 kWh	7,427 kWh
#1 Oil	2,266 gallons	387 gallons
Hot Wtr District Ht	0.00 million Btu	222.71 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	EUI/HDD	ECI

	(kBtu/Sq.Ft.)	(Btu/Sq.Ft./HDD)	(\$/Sq.Ft.)
Existing Building	188.9	13.23	\$9.71
With Proposed Retrofits	157.4	11.03	\$4.02
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 Stebbins Old WTP. 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, SIR¹	Simple Payback (Years)²	CO₂ Savings
1	Setback Thermostat: Old Water Treatment Plant	Lower temperature to 60.0 deg. F when unoccupied in the Old Water Treatment Plant space.	\$803	\$2,000	5.40	2.5	4,367.5
2	Garage Door	Add insulating blanket to garage door.	\$140	\$434	4.34	3.1	762.3
3	Other Electrical - Combined Retrofit: Washeteria & Clinic Pressure Pump	Replace with new pressure pump	\$3,625	\$12,000	3.21	3.3	10,307.1
4	Lighting - Power Retrofit: Main Area Lighting	Replace with new energy-efficient lighting	\$222 + \$60 Maint.	\$1,200	3.31	4.2	519.9
5	Lighting - Power Retrofit: Other Area Lighting	Replace with new energy-efficient lighting	\$82 + \$42 Maint.	\$840	2.09	6.8	181.9
6	Heating, Ventilation, and Domestic Hot Water	Implement a heat recovery system, new boiler and boiler control system.	\$5,949 + \$300 Maint.	\$100,000	1.49	16.0	28,788.1
	TOTAL, all measures		\$10,821 + \$402 Maint.	\$116,474	1.76	10.4	44,926.9

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 \$10,821 per year, or 58.6% of the buildings' total energy costs. These measures are estimated to cost \$116,474, for an overall simple payback period of 10.4 years. If only the cost-effective measures are implemented, the annual utility cost can be reduced by \$10,821 per year, or 58.6% of the buildings' total energy costs. These measures are estimated to cost \$116,474, for an overall simple payback period of 10.4 years.

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

Table 1.2

Annual Energy Cost Estimate						
Description	Space Heating	Lighting	Other Electrical	Water Circulation Heat	Tank Heat	Total Cost
Existing Building	\$5,694	\$1,274	\$7,142	\$1,897	\$2,391	\$18,458
With Proposed Retrofits	\$3,465	\$984	\$2,086	\$464	\$577	\$7,637
Savings	\$2,229	\$290	\$5,055	\$1,433	\$1,814	\$10,821

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

This audit included services to identify, develop, and evaluate energy efficiency measures at the Stebbins Old 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 Stebbins Old 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.

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

1) Old Water Treatment Plant: 1,900 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 $SIR \geq 1$ 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. Stebbins Old Water Treatment Plant

3.1. Building Description

The 1,900 square foot Stebbins Old Water Treatment Plant was constructed in 1977. Operation for this facility is 24 hours per day for the process pumps, facility heat, etc. However, lighting use is limited to approximately eight hours per day.

The Stebbins Old Water Treatment Plant serves as the primary treatment facility for the City of Stebbins. The building houses the filters, pressure tanks, and fire suppression system for the school. Water is circulated from the Stebbins Old Water Treatment Plant to the school and the clinic. The washeteria is also supplied with hot water and the community watering point is located within the washeteria. A new water treatment plant is under construction for the City of Stebbins and will be completed in summer 2015. When the new water treatment plant is operational, the old water treatment plant will house the school fire suppression system, circulation, heat add, and pressure pumps for and provide additional heat to the school, washeteria, and clinic.

Water is pumped in from a lake approximately three miles outside of town to the Stebbins Old Water Treatment Plant. The water is then pumped through two large sand filter tanks and a second series of before being injected with chlorine and getting stored in one of two large water storage tanks. One storage tank is used for drinking water and the other is used for a fire suppression system. Water from the drinking water storage tank is circulated to the school and clinic buildings as well as the washeteria for use in the washers, dryers, showers, and watering point.

The washeteria is located next to the old water treatment plant. Details on the washeteria are available in a separate energy audit report. The school is located across the street from the old water treatment plant.

Description of Building Shell

The exterior walls are constructed from single stud 2X4 construction with 16 inches spacing and 3.5 inches of R-11 batt insulation. The insulation has some damage and there is approximately 1,728 square feet of wall space.

The roof of the building is constructed from lumber with standard 24 inch framing, a cathedral ceiling, and six inches of R-19 batt insulation. The insulation has some damage and there is approximately 2,003 square feet of roof space.

The building is constructed on pilings with six inches of R-19 batt insulation. The insulation has some damage and there is approximately 1,900 square feet of floor space.

There are a number of windows in the building that are all old, broken, and covered with wood. The windows are all wood framed and cover a total area of approximately 36 square feet.

There is a large garage door and a standard metal door entrance in the building. The garage door has an area of approximately 80 square feet and is uninsulated and rarely used. The standard door is a metal door with an insulated core and has an area of approximately 21 square feet.

Description of Heating Plants

The Heating Plants used in the building are:

Burnham

Fuel Type:	#1 Oil
Input Rating:	191,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Burnham

Fuel Type:	#1 Oil
Input Rating:	191,000 BTU/hr
Steady State Efficiency:	78 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	Dec - Feb

Space Heating Distribution Systems

There are two unit heaters present in the building that provide space heat to the interior of the water treatment plant. The unit heaters combine to use approximately 40,000 BTUH when in operation.

Heat Recovery Information

The Stebbins Old Water Treatment Plant received funding for a heat recovery project from the new power plant. The project will serve the old water treatment plant, new water treatment plant, washeteria, clinic, and school.

Lighting

The main water treatment space of the building has ten fixtures with two T8 fluorescent light bulbs in each fixture.

The fire suppression area of the building has seven fixtures with two T8 fluorescent light bulbs in each fixture.

Plug Loads

The old water treatment plant has a variety of power tools and 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 is a pressure pump that pressurizes the water for the clinic and washeteria use. The pump is constantly running and has an annual usage of approximately 9,809 KWH.

There is a pressure pump that pressurizes the water for the school use. The pump has an annual usage of approximately 1,962 KWH.

There is a circulation pump that circulates glycol for the water storage tank heat-add system. The pump has an annual consumption of approximately 473 KWH.

There is a circulation pump that circulates glycol for the fire suppression water storage tank heat-add system. The pump has an annual consumption of approximately 473 KWH.

There is a backwash pump that is used when water is pumped from the water source and uses approximately 2 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 following is a list of the utility companies providing energy to the building and the class of service provided:

Electricity: AVEC-Stebbins - 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	\$ 0.52/kWh
#1 Oil	\$ 3.78/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Stebbins pays approximately \$18,458 annually for electricity and other fuel costs for the Stebbins Old 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

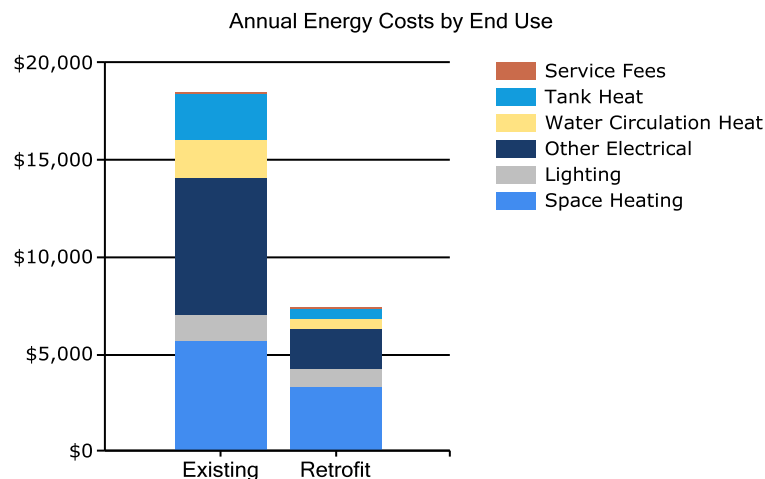


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

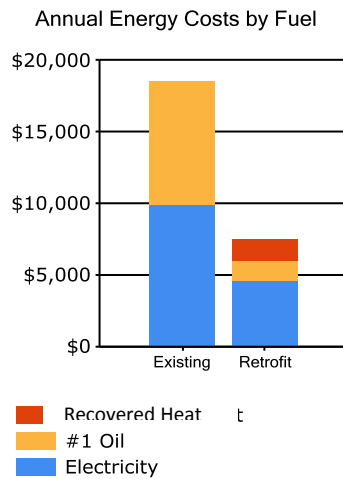
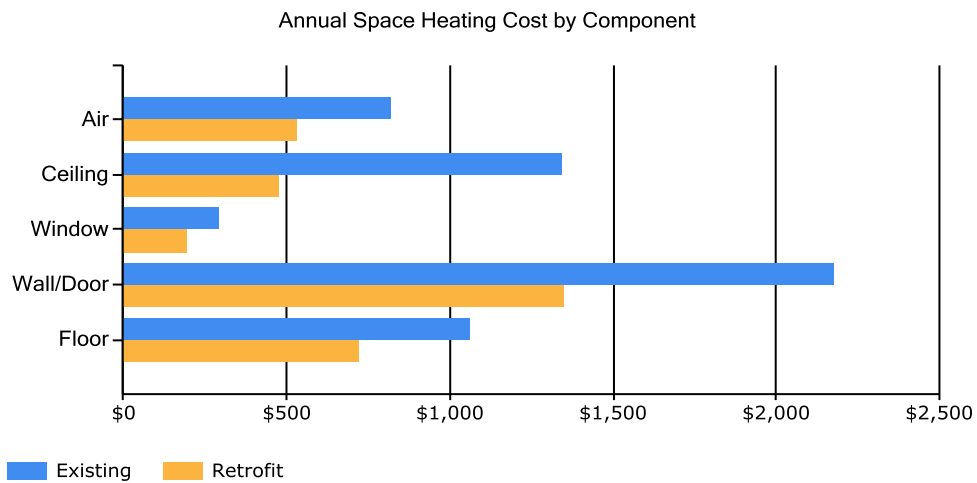


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing 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	252	229	242	211	184	161	160	162	170	204	221	254
Lighting	193	176	193	186	193	186	193	193	186	193	186	193
Other_Electrical	1079	984	1080	1045	1079	1045	1079	1079	1045	1079	1045	1079
Water_Circulation_Heat	2	2	2	2	3	4	5	5	4	3	2	2
Tank_Heat	6	6	6	4	2	0	0	0	1	3	4	6

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	185	159	158	111	53	20	5	10	37	88	128	189
Water_Circulation_Heat	38	35	38	38	42	46	51	50	43	40	38	38
Tank_Heat	102	99	100	69	26	0	0	0	7	46	73	106

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):

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

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Fuel Oil Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

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

Table 3.4
Stebbins Old WTP 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	17,513 kWh	59,772	3.340	199,640
#1 Oil	2,266 gallons	299,107	1.010	302,099
Total		358,880		501,739
BUILDING AREA		1,900	Square Feet	
BUILDING SITE EUI		189	kBTU/Ft ² /Yr	
BUILDING SOURCE EUI		264	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	188.9	13.23	\$9.71
With Proposed Retrofits	157.4	11.03	\$4.02
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 Stebbins Old Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Stebbins 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 Stebbins. 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 heating and ventilation 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 Stebbins Old WTP, Stebbins, 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	Setback Thermostat: Old Water Treatment Plant	Lower temperature to 60.0 deg. F when unoccupied in the Old Water Treatment Plant space.	\$803	\$2,000	5.40	2.5	4,367.5
2	Garage Door	Add insulating blanket to garage door.	\$140	\$434	4.34	3.1	762.3
3	Other Electrical - Combined Retrofit: Washeteria & Clinic Pressure Pump	Replace with new pressure pump	\$3,625	\$12,000	3.21	3.3	10,307.1
4	Lighting - Power Retrofit: Main Area Lighting	Replace with new energy-efficient lighting	\$222 + \$60 Maint.	\$1,200	3.31	4.2	519.9
5	Lighting - Power Retrofit: Other Area Lighting	Replace with new energy-efficient lighting	\$82 + \$42 Maint.	\$840	2.09	6.8	181.9
6	Heating, Ventilation, and Domestic Hot Water	Implement a heat recovery system, new boiler and boiler control system.	\$5,949 + \$300 Maint.	\$100,000	1.49	16.0	28,788.1

Table 4.1
Stebbins Old WTP, Stebbins, 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
	TOTAL, all measures		\$10,821 + \$402 Maint.	\$116,474	1.76	10.4	44,926.9

4.2 Interactive Effects of Projects

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

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

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

4.3 Building Shell Measures

4.3.1 Door Measures

Rank	Location	Size/Type, Condition			Recommendation	
2	Garage Door: Garage Door	Door Type: 1-piece 8'x7' door, EPS core, 1-3/8" Insulating Blanket: None Modeled R-Value: 2.8			Add R-3.5 insulating blanket to garage door.	
Installation Cost		\$434	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$140
Breakeven Cost		\$1,883	Savings-to-Investment Ratio	4.3	Simple Payback yrs	3
Auditors Notes: The garage door is rarely used and is treated like wall space. There is little insulating value on the garage door and hanging a blanket or cover of some sort will prevent heat from escaping through the door.						

4.4 Mechanical Equipment Measures

4.4.1 Heating /Domestic Hot Water Measure

Rank	Recommendation				
7	Implement a heat recovery system, new boiler and boiler control system.				
Installation Cost	\$100,000	Estimated Life of Measure (yrs)	30	Energy Savings (/yr)	\$5,489
				Maintenance Savings (/yr)	\$300
Breakeven Cost	\$137,524	Savings-to-Investment Ratio	1.4	Simple Payback yrs	17
Auditors Notes: The heat recovery system will recover heat from the power plant to serve this building and four others. New boilers will be added during the project to replace the existing old units and controls will be added to allow the boilers to complement the heat recovery system.					

4.4.2 Night Setback Thermostat Measures

Rank	Building Space	Recommendation			
1	Old Water Treatment Plant	Lower the temperature to 60 deg. F when unoccupied for the Old Water Treatment Plant space.			
Installation Cost	\$2,000	Estimated Life of Measure (yrs)	15	Energy Savings (/yr)	\$803
Breakeven Cost	\$10,791	Savings-to-Investment Ratio	5.4	Simple Payback yrs	2
Auditors Notes: Use a thermostat to lower the air temperature during periods when nobody is using the building. This reduces the heating demand of the building.					

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 and cooling loads. The building cooling load will see a small decrease from an upgrade to more efficient bulbs and the heating load will see a small increase, as the more energy efficient bulbs give off less heat.

4.5.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition	Recommendation		
4	Main Area Lighting	10 FLUOR (2) T8 4' F32T8 32W Standard Instant Standard Electronic with Manual Switching	Replace with new energy-efficient lighting.		
Installation Cost	\$1,200	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$222
				Maintenance Savings (/yr)	\$60
Breakeven Cost	\$3,967	Savings-to-Investment Ratio	3.3	Simple Payback yrs	4
Auditors Notes: Convert from 32 watt T8 fluorescent to 17 watt LED with no ballast.					

Rank	Location	Existing Condition	Recommendation		
5	Other Area Lighting	7 FLUOR (2) T8 4' F32T8 32W Standard Instant Standard Electronic with Manual Switching	Replace with new energy-efficient lighting.		
Installation Cost	\$840	Estimated Life of Measure (yrs)	20	Energy Savings (/yr)	\$82
				Maintenance Savings (/yr)	\$42
Breakeven Cost	\$1,755	Savings-to-Investment Ratio	2.1	Simple Payback yrs	7
Auditors Notes: Convert from T8 32 watt fluorescent to 17 watt LED and eliminate ballast.					

4.5.2 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation			
3	Washeteria & Clinic Pressure Pump	Pressure Pump	Adjust pump such that it is not running continuously and only runs when system needs additional pressure.			
Installation Cost		\$12,000	Estimated Life of Measure (yrs)	14	Energy Savings (/yr)	\$3,625
Breakeven Cost		\$38,504	Savings-to-Investment Ratio	3.2	Simple Payback yrs	3
Auditors Notes: Repair or replace and re-commission pressure switch. The pump currently runs constantly and the pressure controls are broken. The witch needs to be repaired or the pump needs to be replaced.						

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 City of Stebbins 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 city with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2015 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	AUDITOR INFORMATION
Building: Stebbins Old WTP	Auditor Company: ANTHC-DEHE
Address: P O Box 22	Auditor Name: Carl Remley, Kevin Ulrich, and Simon Evans
City: Stebbins	Auditor Address: 3900 Ambassador Drive, Suite 301 Anchorage, AK 99508
Client Name: Peter	
Client Address: P O Box 22 Stebbins, AK 99671	Auditor Phone: (907) 729-3543
Client Phone: (907) 944-1349	Auditor FAX:
Client FAX:	Auditor Comment:
Design Data	
Building Area: 1,900 square feet	Design Space Heating Load: Design Loss at Space: 39,233 Btu/hour with Distribution Losses: 41,298 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 62,954 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: Stebbins	Design Outdoor Temperature: -34 deg F
Weather/Fuel City: Stebbins	Heating Degree Days: 14,272 deg F-days
Utility Information	
Electric Utility: AVEC-Stebbins - Commercial - Sm	Natural Gas Provider: None
Average Annual Cost/kWh: \$0.565/kWh	Average Annual Cost/ccf: \$0.000/ccf

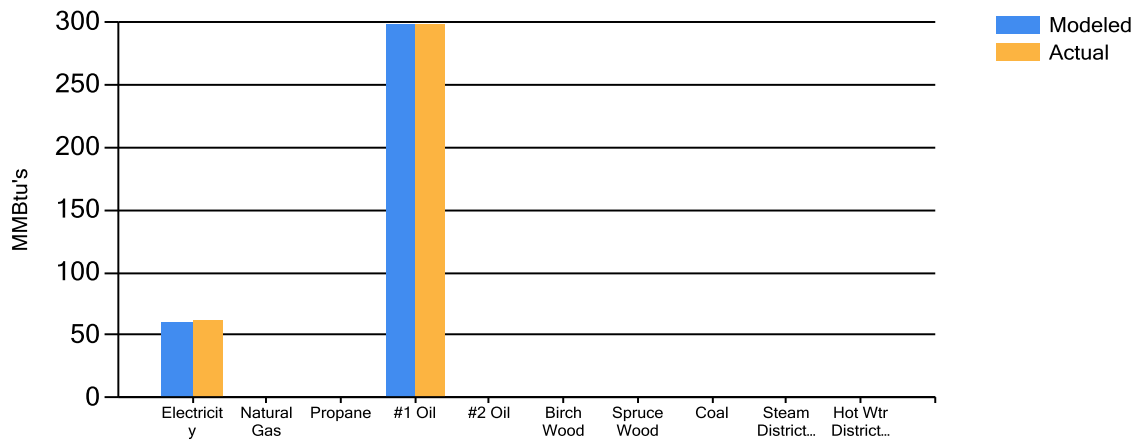
Annual Energy Cost Estimate						
Description	Space Heating	Lighting	Other Electrical	Water Circulation Heat	Tank Heat	Total Cost
Existing Building	\$5,694	\$1,274	\$7,142	\$1,897	\$2,391	\$18,458
With Proposed Retrofits	\$3,465	\$984	\$2,086	\$464	\$577	\$7,637
Savings	\$2,229	\$290	\$5,055	\$1,433	\$1,814	\$10,821

Building Benchmarks			
Description	EUI (kBtu/Sq.Ft.)	EUI/HDD (Btu/Sq.Ft./HDD)	ECI (\$/Sq.Ft.)
Existing Building	188.9	13.23	\$9.71
With Proposed Retrofits	157.4	11.03	\$4.02
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.			

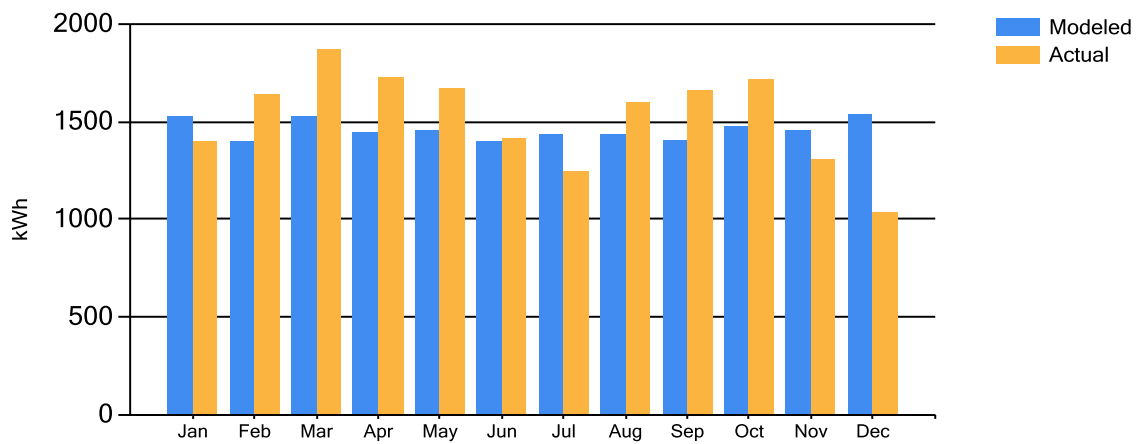
Appendix B – Actual Fuel Use versus Modeled Fuel Use

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

