Comprehensive Energy Audit
For
Tununak Water Treatment Plant & Well House

Prepared For
Native Village of Tununak

June 12, 2012

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PREFACE

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

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

ACKNOWLEDGMENTS

The Energy Projects Group gratefully acknowledges the assistance of James James, Tribal Administrator, and Vincent, Water Plant Operator for the Native Village of Tununak.

1. EXECUTIVE SUMMARY

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

Based on electricity and fuel oil prices in effect at the time of the audit, the annual predicted energy costs for the buildings analyzed are $7,847 for Electricity and $14,672 for #1 Oil. The total energy costs are $22,519 per year.

It should be noted that this facility received the power cost equalization (PCE) subsidy from the state of Alaska last year. If this facility had not received PCE, total electrical costs would have been $18,309.

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

		Table 1.1				
		PRIORITY LIST – ENERGY EFFICIENCY MEASURES				
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR[1]	Simple Payback (Years)[2]
1	Other Electrical - Controls Retrofit: Heat Tape	Disconnect hard wired heat tape on the old watering point loop.	$844	$10	522.19	0.0
2	Other Electrical - Controls Retrofit: Well House Electrical Load	Lower heating set point to 40 degrees in the well house.	$1,030	$500	17.34	0.5
3	HVAC And DHW	Clean and tune boilers to increase efficiency. This estimate assumes a technician travels from Anchorage and works with the water plant operator and teaches him how to clean the boiler.	$526	$4,000	2.29	7.6
4	Cathedral Ceiling: WTP	Fill empty 2x6 cavity with R-19 fiberglass batts.	$1,127	$12,230	2.18	10.9
5	Exposed Floor: WTP	Remove insulation from 2x6 cavity and replace with R-21 dense-pack blown-in insulation.	$663	$10,024	1.57	15.1
6	Window: WTP	Remove existing glass and replace with double pane,low-E,argon glass.	$51	$786	1.13	15.3
	TOTAL, cost-effective measures		$4,241	$27,551	2.41	6.5
	The following measures were *not* found to be cost-effective:					
7	Window/Skylight: WTP	Remove existing glass and replace with double pane,low-E,argon glass.	$85	$1,573	0.94	18.5

	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]
	TOTAL, all measures		$4,326	$29,123	2.33	6.7

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 $4,326 per year, or 19.2% of the buildings' total energy costs. These measures are estimated to cost $29,123, for an overall simple payback period of 6.7 years. If only the cost-effective measures are implemented, the annual utility cost can be reduced by $4,241 per year, or 18.8% of the buildings' total energy costs. These measures are estimated to cost $27,551, for an overall simple payback period of 6.5 years.

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

		Table 1.2 Annual Energy Cost Estimate								
Description	Space Heating	Space Cooling	Water Heating	Lighting	Refrigeration	Other Electrical	Cooking	Clothes Drying	Ventilation Fans	Total Cost
Existing Building	$6,638	$0	$2,771	$809	$0	$2,619	$5,769	$3,914	$0	**$22,519**
With All Proposed Retrofits	$4,428	$0	$2,528	$809	$0	$745	$5,769	$3,914	$0	**$18,193**
SAVINGS	$2,210	$0	$243	$0	$0	$1,873	$0	$0	$0	**$4,326**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

2.2 Audit Description

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

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

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

Details collected from Tununak Water Treatment Plant & Well House 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.

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

   1) Water Plant, Washeteria & Well House: 2,048 square feet

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

- Local climate conditions
- Prices paid for energy

2.3. Method of Analysis

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

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

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

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

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

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

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

Measures are implemented in order of cost-effectiveness. The program first calculates individual SIRs, and ranks all measures by SIR, higher SIRs at the top of the list. An individual measure must have an individual SIR>=1 to make the cut. Next the building is modified and re-simulated with the highest ranked measure included. Now all remaining measures are re-

evaluated and ranked, and the next most cost-effective measure is implemented. AkWarm goes through this iterative process until all appropriate measures have been evaluated and installed.

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

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

2.4 Limitations of Study

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

3. Tununak Water Treatment Plant & Well House

3.1. Building Description

The 2,048 square foot Tununak Water Treatment Plant & Well House was constructed in 1982, with a normal occupancy of two people. The number of hours of operation for this building average 6 hours per day, considering all seven days of the week.

The water plant is servicing three washing machines and a small circulation loop to the nearby clinic. Circulation loops for village watering points and the washeteria are no longer used, the BIA in town provides those services. Water is sourced from an electrically heated well house on the edge of town.

Water is storage in a 50,000 gallon water storage tank with 5" of insulation in fair to good condition and metal siding.

Description of Building Shell

The exterior walls are 2x4 construction with 3.5 inches of fiberglass batt insulation.

The roof of the building is a warm roof with 3.5 inches of fiberglass batt insulation.

The floor of the building is built on pilings with 3.5 inches of fiberglass batt insulation.

Typical windows throughout the building are double paned glass windows, though there are several broken windows.

Exterior doors in the facility are of metal construction.

Description of Heating Plants

The Heating Plants used in the building are:

Burnham PF-35
       Fuel Type: #1 Oil
       Input Rating: 375,000 BTU/hr
       Steady State Efficiency: 80 %
       Idle Loss: 1.5 %
       Heat Distribution Type: Glycol
       Boiler Operation: All Year

Space Heating Distribution Systems

The building is currently heated primarily by jacket losses off the boiler, however there are three unit heaters which do run occasionally. When the facility is cold in the winter, the operator will exhaust the dryers into the facility to provide heat.

Dryer exhaust air should always be exhausted to the exterior of the facility. Increased humidity will degrade insulation value and not result in energy savings as anticipated.

Domestic Hot Water System

An amtrol in line 55 gallon hot water tank is heated by the boilers. The facility only uses about 20 gallons of hot water per day in the washing machines.

Lighting

Lighting in the facility is made up of eleven T12 magnetic ballast, fluorescent fixtures, each with a mixture of 34 watt or 40 watt four foot bulbs.

Plug Loads

A radio, a microwave and an air blower make up the majority of the plug loads in the facility.

Major Equipment

Significant energy using equipment in the facility includes a one horsepower pressure pump running 3% of the time.

There are two smaller speed queen washing machines, and one large washing machine which are used more regularly.

There is an old heat tape in the facility that appeared to be disconnected and shut off that serviced the old watering points. The heat tape was actually hard wired and had not been shut off. This was repaired by the operator at the time of the audit.

The water storage tank is circulated with a Grundfos UP 15-42SF circulation pump which maintains the temperature of the storage tank at about 40 degrees.

The electric dryer in the facility are Speed Queen Model STO30EBCK4GZW02. The dryer uses about 13 kilowatts when it's on, which is about 20 hours per week.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour.

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

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

Electricity: AVEC-Tununak - 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	$ 0.21/kWh
#1 Oil	$ 6.75/gallon

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, Native Village of Tununak pays approximately $22,519 annually for electricity and other fuel costs for the Tununak Water Treatment Plant & Well House.

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**
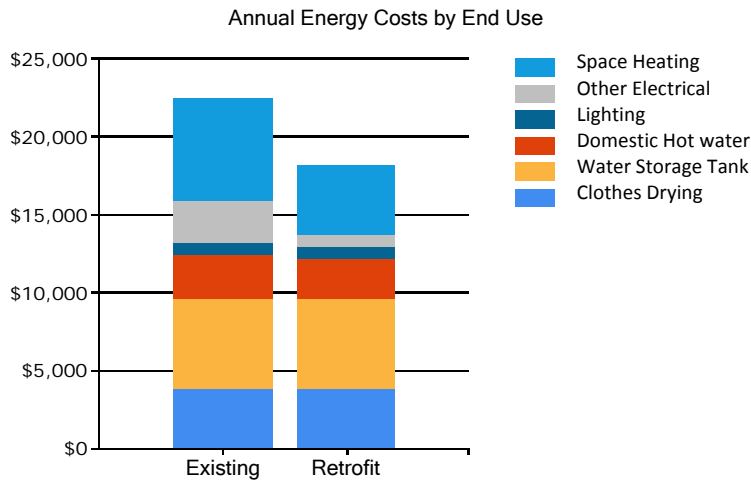

Annual Energy Costs by End Use

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**
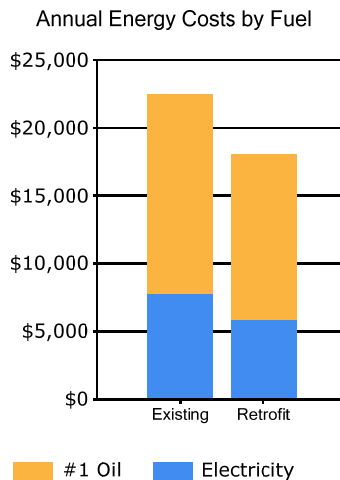

Annual Energy Costs by Fuel

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

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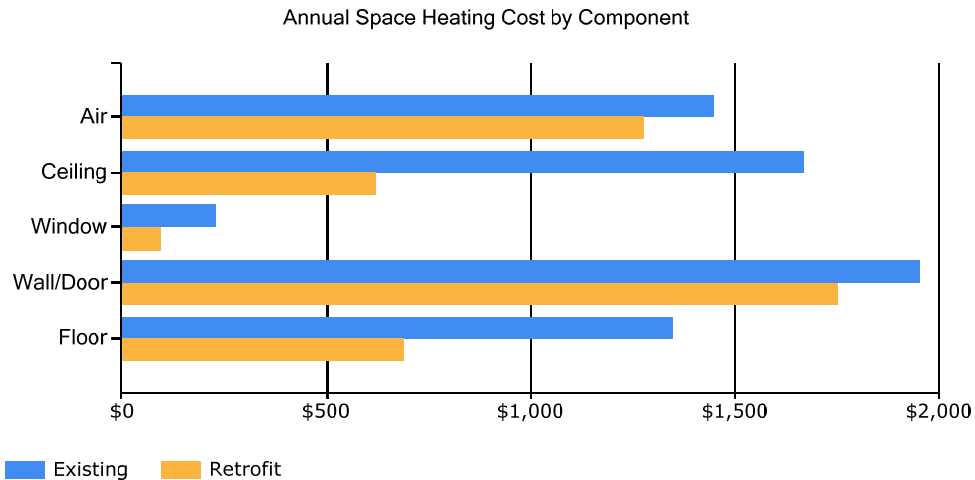
The tables below show AkWarm's estimate of the monthly fuel use for each of the fuels used in the building. For each fuel, the fuel use is broken down across the energy end uses. Note, in the tables below "DHW" refers to Domestic Hot Water heating.

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Lighting	327	298	327	316	327	316	327	327	316	327	316	327
Other_Electrical	1342	1223	1342	1298	1342	478	494	494	478	1342	1298	1342
Water Storage Tank	160	146	160	155	160	155	160	160	155	160	155	160
Clothes_Drying	2102	1915	2102	2034	2102	36	37	37	2034	2102	2034	2102
DHW	2	1	2	3	7	7	7	7	7	4	2	1
Space_Heating	82	72	65	35	12	11	12	12	11	27	52	82

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Water Storage Tank	101	92	101	98	101	0	0	0	0	101	98	101
DHW	23	21	24	27	48	46	48	48	46	32	24	23
Space_Heating	190	167	149	73	6	6	6	6	6	51	117	191

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):

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

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

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

Table 3.4
Tununak Water Treatment Plant & Well House 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	37,367 kWh	127,533	3.340	425,961
#1 Oil	2,174 gallons	286,928	1.010	289,797
Total		**414,461**		**715,758**

BUILDING AREA	2,048	Square Feet
BUILDING SITE EUI	202	kBTU/Ft²/Yr
BUILDING SOURCE EUI	349	**kBTU/Ft²/Yr**
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.		

3.3 AkWarm© Building Simulation

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

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

For the purposes of this study, the Tununak Water Treatment Plant & Well House was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Tununak 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 Tununak. This data represents the average ambient weather profile as observed over approximately 30 years. As such, the gas and electric profiles generated will not likely compare perfectly with actual energy billing information from any single year. This is especially true for years with extreme warm or cold periods, or even years with unexpectedly moderate weather.
• The heating and cooling load model is a simple two-zone model consisting of the building's core interior spaces and the building's perimeter spaces. This simplified approach loses accuracy for buildings that have large variations in cooling/heating loads across different parts of the building.
• The model does not model HVAC systems that simultaneously provide both heating and cooling to the same building space (typically done as a means of providing temperature control in the space).

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

4. ENERGY COST SAVING MEASURES

4.1 Summary of Results

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

Table 4.1 Tununak Water Treatment Plant & Well House, Tununak, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES						
Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
1	Other Electrical - Controls Retrofit: Heat Tape	Disconnect hard wired heat tape on the old watering point loop.	$844	$10	522.19	0.0

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)
		Table 4.1 **Tununak Water Treatment Plant & Well House, Tununak, Alaska** **PRIORITY LIST – ENERGY EFFICIENCY MEASURES**				
2	Other Electrical - Controls Retrofit: Well House Electrical Load	Lower heating set point to 40 degrees in the well house.	$1,030	$500	17.34	0.5
3	HVAC And DHW	Clean and tune boilers to increase efficiency. This estimate assumes a technician travels from Anchorage and works with the water plant operator and teaches him how to clean the boiler.	$526	$4,000	2.29	7.6
4	Cathedral Ceiling: WTP	Fill empty 2x6 cavity with R-19 fiberglass batts.	$1,127	$12,230	2.18	10.9
5	Exposed Floor: WTP	Remove insulation from 2x6 cavity and replace with R-21 dense-pack blown-in insulation.	$663	$10,024	1.57	15.1
6	Window: WTP	Remove existing glass and replace with double pane,low-E,argon glass.	$51	$786	1.13	15.3
	TOTAL, cost-effective measures		**$4,241**	**$27,551**	**2.41**	**6.5**
	The following measures were *not* found to be cost-effective:					
7	Window/Skylight: WTP	Remove existing glass and replace with double pane,low-E,argon glass.	$85	$1,573	0.94	18.5
	TOTAL, all measures		**$4,326**	**$29,123**	**2.33**	**6.7**

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 Insulation Measures

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value
4	Cathedral Ceiling: WTP	Framing Type: Standard Framing Spacing: 24 inches Insulated Sheathing: None Bottom Insulation Layer: None Top Insulation Layer: R-11 Batt:FG or RW, 3.5 inches Insulation Quality: Damaged Modeled R-Value: 13.3	Fill empty 2x6 cavity with R-19 fiberglass batts.

Installation Cost	$12,230	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$1,127
Breakeven Cost	$26,654	**Savings-to-Investment Ratio**	2.2	**Simple Payback yrs**	11

Auditors Notes: Adding fiberglass batt insulation to the ceiling would reduce the heating load in the facility.

Rank	Location	Existing Type/R-Value	Recommendation Type/R-Value
5	Exposed Floor: WTP	Framing Type: 2 x Lumber Insulating Sheathing: None Top Insulation Layer: R-11 Batt:FG or RW, 3.5 inches Bottom Insulation Layer: None Insulation Quality: Damaged Modeled R-Value: 15.5	Remove insulation from 2x6 cavity and replace with R-21 dense-pack blown-in insulation.

Installation Cost	$10,024	**Estimated Life of Measure (yrs)**	30	**Energy Savings (/yr)**	$663
Breakeven Cost	$15,694	**Savings-to-Investment Ratio**	1.6	**Simple Payback yrs**	15

Auditors Notes: Replacing the insulation in the floor would reduce the heating load in the facility.

4.3.2 Window Measures

Rank	Location	Size/Type, Condition	Recommendation
6	Window/Skylight: WTP	Glass: No glazing - broken, missing Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.11	Remove existing glass and replace with double pane,low-E,argon glass.

Installation Cost	$786	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$51
Breakeven Cost	$891	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	15

Auditors Notes: Replacing broken windows with new double paned windows would reduce the heating load in the building.

Rank	Location	Size/Type, Condition	Recommendation
7	Window/Skylight: WTP	Glass: No glazing - broken, missing Frame: Wood\Vinyl Spacing Between Layers: Half Inch Gas Fill Type: Air Modeled U-Value: 0.94 Solar Heat Gain Coefficient including Window Coverings: 0.11	Remove existing glass and replace with double pane,low-E,argon glass.

Installation Cost	$1,573	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$85
Breakeven Cost	$1,477	**Savings-to-Investment Ratio**	0.9	**Simple Payback yrs**	19

Auditors Notes: Replacing broken windows with new double paned windows would reduce the heating load in the building. Though replacing the south facing windows that are broken doesn't pay back individually, if done at the same time as the other windows, it would be an acceptable payback period.

4.4 Mechanical Equipment Measures

4.4.1 Heating/Cooling/Domestic Hot Water Measure

Rank	Recommendation
3	Clean and tune boilers to increase efficiency. This estimate assumes a technician travels from Anchorage and works with the water plant operator and teaches him how to clean the boiler.

Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$526
Breakeven Cost	$9,145	**Savings-to-Investment Ratio**	2.3	**Simple Payback yrs**	8

Auditors Notes:

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.

4.5.3 Other Electrical Measures

Rank	Location	Description of Existing	Efficiency Recommendation
1	Heat Tape	Old Heat Tape for Watering Points with Manual Switching	Improve Manual Switching

Installation Cost	$10	**Estimated Life of Measure (yrs)**	7	**Energy Savings (/yr)**	$844
Breakeven Cost	$5,222	**Savings-to-Investment Ratio**	522.2	**Simple Payback yrs**	0

Auditors Notes: Heat Tape was repaired on site by the operator under the supervision of Chris Mercer of ANTHC. This heat tape is no longer needed since the watering point is no longer used.

Rank	Location	Description of Existing	Efficiency Recommendation	
2	Well House Electrical Load	Well House electrical Loads with Manual Switching	Improve Manual Switching	
Installation Cost	$500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$1,030
Breakeven Cost	$8,672	**Savings-to-Investment Ratio**	17.3	**Simple Payback yrs**	0
Auditors Notes: The well house facility only needs to be kept from freezing. The temperature set point on the electric heat should be set and locked to 40 degrees.				

5. ENERGY EFFICIENCY ACTION PLAN

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

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

Appendix A – Listing of Energy Conservation and Renewable Energy Websites

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

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

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

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

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

Hot Water Heaters

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

Solar Water Heating

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

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

Plug Loads

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

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

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

Wind

AWEA Web Site – http://www.awea.org

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

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

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

Homepower Web Site: http://homepower.com

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

Solar

NREL – http://www.nrel.gov/rredc/

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

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

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