Comprehensive Energy Audit
For

Kake Water Treatment Plant and Water Dam

Prepared For
City of Kake

August 9, 2016

Prepared By:

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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 Rural Energy Initiative at the Alaska Native Tribal Health Consortium (ANTHC) prepared this document for The City of Kake, Alaska. The authors of this report are Kevin Ulrich, Energy Manager-in-Training (EMIT); Don Green, Senior Utility Operations Specialist; and Timothy Eby, Assistant Engineer.

The purpose of this report is to provide a comprehensive document of the findings and analysis that resulted from an energy audit conducted in May of 2016 by the Rural Energy Initiative 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 Rural Energy Initiative gratefully acknowledges the assistance of Water Treatment Plant Lead Operator Kip Howard, Water Treatment Plant Secondary Operator Roy Kadake, and Kake City Manager Rudy Bean.

1. EXECUTIVE SUMMARY

This report was prepared for the City of Kake. The scope of the audit focused on Kake Water Treatment Plant, Water Dam, and Lift Stations. The scope of this report is a comprehensive energy study, which included an analysis of water treatment processes, lift station operations, 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 the City of Kake to follow up on the recommendations made in this report. Funding has been provided by to ANTHC through a Rural Alaska Village Grant to provide the community with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2016 calendar year.

The total predicted energy cost for the all facilities related to the Kake Water Treatment Plant is $38,374 per year. Electricity represents the largest portion with an annual cost of approximately $36,833. This includes approximately $13,971 paid by the city and $22,864 paid by the Power Cost Equalization (PCE) program through the State of Alaska. Fuel oil represents the remaining portion of energy consumption with an annual cost of approximately $1,541.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower the electricity costs and make energy in rural Alaska affordable. In Kake, the cost of electricity without PCE is $0.58/kWh, and the cost of electricity with PCE is $0.22/kWh. For the purposes of this report, electricity costs and savings are calculated using the $0.58 per kilowatt hour rate.

In addition to the water treatment plant, there is a water dam with a small building that contains the controls and other equipment to assist with the water intake process from the dam site. There are also four lift stations throughout the town that were assessed to determine the operational status of each. A large leak detection effort is currently underway in the community as well as a large effort to replace all of the existing water distribution pipe within the community.

Table 1.1 lists the total usage of electricity and #1 heating in all buildings before and after the proposed retrofits.

Table 1.1: Predicted Annual Fuel Usage for Each Fuel Type

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	63,505 kWh	47,258 kWh
#2 Oil	411 gallons	355 gallons

Benchmark figures facilitate comparing energy use between different buildings. Table 1.2 lists several benchmarks for the audited building. More details can be found in section 3.2.2.

Table 1.2: Building Benchmarks for the Kake Water Treatment Plant and Water Dam

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	152.6	17.90	$21.41
With Proposed Retrofits	117.4	13.76	$16.04
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 1.3 below summarizes the energy efficiency measures analyzed for the Kake Water Treatment Plant. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.3: Summarized Priority List of All Energy Recommendations for the Kake Water Treatment Plant and Water Dam

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: Ice Maker	Relocate Ice Maker to a different location.	$1,859	$250	87.33	0.1	5,447.8
2	Other Electrical: Chlorine Room Electric Heater	Install thermostat and lower temperature to 50 deg. F.	$1,818	$2,000	10.26	1.1	3,982.1
3	Lighting: Entryway Lights	Replace with new energy-efficient LED lighting.	$128	$160	9.13	1.2	306.1
4	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg. F for the Water Treatment Plant space.	$727	$2,000	4.90	2.8	4,189.5
5	Other Electrical: Water Dam - Electric Heaters	Install thermostat and lower temperature to 50 deg. F.	$1,839	$5,000	4.32	2.7	5,390.8
6	Lighting: Mezzanine Lights	Replace with new energy-efficient LED lighting and add new occupancy sensor.	$177	$560	3.61	3.2	433.0
7	Lighting: Water Dam - Exterior Lights	Replace with new energy-efficient LED lighting.	$730	$2,500	3.43	3.4	2,139.2
8	Other Electrical: Bean Lift Station - Sewage Pumps	Repair leaks in houses to reduce pump usage (already completed).	$1,328	$5,000	3.12	3.8	3,891.0
9	Lighting: Office Lights	Replace with new energy-efficient LED lighting and add new occupancy sensor.	$141	$560	2.89	4.0	343.9
10	Lighting: Exterior Lights - HPS	Replace with new energy-efficient LED lighting.	$99	$500	2.32	5.1	290.1

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**
11	Lighting: Process Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$472	$2,500	2.15	5.3	1,103.5
12	Lighting: Water Dam - Interior	Replace with new energy-efficient LED lighting.	$20	$160	1.50	7.9	59.7
13	Air Tightening	Add weather stripping to garage door and around side entrance.	$90	$750	1.12	8.3	521.4
14	Lighting: AML Lift Station - Incan. Lights	Replace with new energy-efficient LED lighting.	$9	$100	1.11	10.6	27.6
15	Lighting: Hallingstad Lift Station - Incan. Lights	Replace with new energy-efficient LED lighting.	$9	$100	1.11	10.6	27.6
16	Lighting: Community Building Lift Station - Incan. Light	Replace with new energy-efficient LED lighting.	$5	$50	1.11	10.6	13.8
17	Window: Office Window - South	Remove existing glass and replace with double pane glass.	$27	$493	0.96	18.1	157.5
18	Lighting: Task Lighting	Replace with new energy-efficient LED lighting.	$12	$160	0.88	12.9	28.4
19	Garage Door	Add insulating blanket to garage door.	$31	$764	0.55	24.7	178.2
20	Lighting: Chlorine Room Lighting	Replace with new energy-efficient LED lighting.	$4	$100	0.32	26.0	8.8
21	Lighting: AML Lift Station - Metal Halide Lights	Replace with new energy-efficient LED lighting.	$51	$2,000	0.30	39.0	150.5
22	Lighting: Hallingstad Lift Station - Metal Halide Lights	Replace with new energy-efficient LED lighting.	$51	$2,000	0.30	39.0	150.5
23	Lighting: Community Building Lift Station - Interior Lights	Replace with new energy-efficient LED lighting.	$4	$160	0.26	44.7	10.5
	TOTAL, all measures		**$9,633**	**$27,868**	**4.06**	**2.9**	**28,851.7**

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 $9,633 per year, or 25.1% of the buildings' total energy costs. These measures are estimated to cost $27,868, for an overall simple payback period of 2.9 years.

Table 1.4 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 1.4: Annual Energy Cost Estimate Broken Down by Category

Annual Energy Cost Estimate					
Description	**Space Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$1,608	$11	$3,164	$33,592	**$38,374**
With Proposed Retrofits	$1,390	$11	$1,069	$26,272	**$28,742**
Savings	$218	$0	$2,095	$7,319	**$9,633**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

The Kake Water Treatment Plant has an area of approximately 1,792 square feet. In addition to the water treatment plant, this audit covers four lift stations and the water dam.

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. Kake Water Treatment Plant

3.1. Building Description

The 1,792 square foot Kake Water Treatment Plant was constructed in 1990, with a normal occupancy of one person. The number of hours of operation for this building average five hours per day throughout the week.

The Kake Water Treatment plant serves as central location for the water treatment and distribution processes for the community. The plant has four large sand filters that process the gravity-fed water and send it to the 375,000 gallon water storage tank. Water is then transported to the city distribution system. The water storage tank has an overflow line that allows excess water to flow back into the nearby Gunnuk Creek.

During the site visit, many leaks were present on the water storage tank, especially near the bolted joints of the tank wall sections. Additionally, the tank walls were bowed such that the circumference of the tank near the bottom was greater than the circumference of the tank near the top. This can cause structural concerns within the tank wall. These concerns should be addressed with any effort for a long-term project at the water treatment plant.

Figure 3.1: The 375,000 gallon water storage tank at the water treatment plant site.

Water is supplied from an intake in a lake approximately six miles north of the town. The water is gravity fed to the water treatment plant where it enters the filters. Water is also supplied by the water dam at Gunnuk Creek approximately 400 ft. from the facility. The water dam has two

20 HP pumps that can be used to pump water from the creek to the water treatment plant in emergency scenarios. The water is injected with chlorine, soda ash, and polymer before entering the water storage tank.

Figure 3.2: Water intake well near the water supply lake.

Figure 3.3: Water Dam Structure

Figure 3.4: Water Dam building on top of the concrete structure.

There are four lift stations throughout the town that were also assessed as part of the energy audit. Each of the lift stations collects sewage from the buildings in the area and pumps the sewage out of town. The AML lift station serves the eastern part of the community, the Hallingstad lift station serves the central part of the community, the Community Hall lift station serves the western part of the community, and the Bean's Point lift station serves a small point in the central part of the community.

Figure 3.5: AML Lift Station

Figure 3.6: Hallingstad Lift Station

Figure 3.7 (Above): Community Building Lift Station

Figure 3.8 (Right): Bean's Point Lift Station

Description of Building Shell

The exterior walls of the water treatment plant are stressed skin panel construction with 5.5 inches of polyurethane foam insulation within the panels. The walls have an average height of 16 ft. and there is approximately 2,639 square feet of wall space. The water dam building is also constructed with stressed skin panels that have an average height of approximately 14 feet. There is approximately 900 square feet of wall space in the building.

The roof of the water treatment plant has a cathedral ceiling with standard-framed panel construction and 5.5 inches of polyurethane foam insulation. There is approximately 1,950 square feet of roof space in the building. The water dam building has the same construction with approximately 250 square feet of roof space.

The water treatment plant is constructed on grade with a gravel pad foundation. There is approximately 1,792 square feet of floor space in the building. The water dam building is constructed on a concrete surface that is part of the dam structure. There is approximately 247 square feet of floor space in the building.

There is one single window in the office that is south facing but that has a broken pane. The window was originally a double paned window with wood framing but is in need of replacement. This window is approximately 35.25" x 35.25" in dimension. There are two sets of double windows on the east wall that are both double paned with wood frames and dimensions of approximately 35.5" x 59.5". One double window is in the office and one is in the process room. The water dam building has four windows that are high on the walls and are double-paned with wood framing. The windows are estimated to be 18" x 40" in dimension.

The water treatment plant main entrance has a single insulated metal door with no glass that is approximately 3' x 6'8" in dimension. The side entrance and the chlorine room each have a single insulated metal door and half-lite windows. The side entry has air leakage through the bottom of the door while the chlorine room door is sealed properly. These doors are approximately 3' x 6'8" in dimension. The water treatment plant also has an abandoned garage door that is insulated and rarely used (it currently has a workbench positioned in front of the entrance). This door is approximately 12' x 16'. The water dam building has a single insulated metal door with no glass that is approximately 3' x 6'8" in dimension.

Description of Heating Plants

The heating plants used in the building are:

Space Heater

Fuel Type:	#2 Oil
Input Rating:	185,000 BTU/hr
Steady State Efficiency:	75 %
Idle Loss:	0 %
Heat Distribution Type:	Air

Figure 3.9: Oil-fired Space Heater in the Water Treatment Plant Process Room.

The water treatment plant has an oil-fired space heater that is used during the winter months to heat the process room. This unit is not connected to any controls and is manually started by the operator when needed. Electric space heaters are located in the chlorine room of the water treatment plant, the water dam building, and in three lift stations. These space heaters are sparingly used during the winter months.

Description of Building Ventilation System

The chlorine room has a fan that is used to provide adequate ventilation to the area before an operator seeks to enter. The fan is rated for 20 CFM and 100 Watts and operates whenever the chlorine room is occupied, which is estimated to be approximately less than 30 minutes per day.

Lighting

The water treatment plant office has two fixtures with four Y8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately five hours per day when the operators are present and consume approximately 411 kWh annually.

The water treatment plant entryway has two fixtures with four Y8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately five hours per day when the operators are present and consume approximately 411 kWh annually.

The water treatment plant process room has four high bay fixtures with a metal halide 150 Watt light bulb in each fixture. The lights are on approximately five hours per day when the operators are present and consume approximately 1,233 kWh annually.

The water treatment plant process room has two fixtures with four Y8 4ft. fluorescent light bulbs in each fixture that are used for task lighting around the workbench area. The lights are on approximately 30 minutes per day and consume approximately 41 kWh annually.

The water treatment plant mezzanine has two fixtures with four Y8 4ft. fluorescent light bulbs in each fixture. The lights are on approximately 75% of the time during the five hour period when operators are present and consume approximately 394 kWh annually.

The chlorine room has a single incandescent 60 Watt light bulb that operates when the room is occupied and consumes approximately 11 kWh annually.

The exterior of the water treatment plant has two LED 10 Watt light fixtures, one high pressure sodium 50 Watt light bulb, and five metal halide 100 Watt light bulbs. These lights operate during the dark hours based on light sensor controls and combine to consume approximately 333 kWh annually.

The water dam building has five exterior light fixtures with a metal halide 100 Watt light bulb in each fixture. The lights are on during the dark hours based on light sensor controls and consume approximately 2,169 kWh annually. The building also has one exterior spotlight with an LED 100 Watt light bulb that only operates when either the exterior equipment is being cleaned or when the log removing equipment is in use during dark hours. The spotlight consumes approximately 21 kWh annually. The building also has two interior light fixtures with two T8 4ft. fluorescent light bulbs in each fixture that operate whenever the building is occupied. These lights consume approximately 120 kWh annually.

The AML lift station has four metal halide 150 Watt light bulbs that operate approximately 30 minutes per day when the operators are present and consume approximately 123 kWh annually. The lift station also has two incandescent 60 Watt light bulbs that consume 22 kWh annually.

The Hallingstad lift station has four metal halide 150 Watt light bulbs that operate approximately 30 minutes per day when the operators are present and consume approximately 123 kWh annually. The lift station also has two incandescent 60 Watt light bulbs that consume 22 kWh annually.

The Community Building lift station has two fixtures with two T8 4ft, fluorescent light bulbs in each fixture. The lights operate approximately 30 minutes per day when the operators are present and consume approximately 21 kWh annually. The lift station also has one incandescent 60 Watt light bulb that consumes 11 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 small chemical injection pumps that are used to inject soda ash and chlorine into the water. Each of the pumps is rated for 22 Watts and the pumps combine to consume approximately 96 kWh annually.

There is a chemical injection pump used to inject polymer into the water. The pump is rated for 168 Watts and consumes approximately 368 kWh annually.

There are two chemical mixer pumps that are used to mix the chemicals in batches before they are injected into the water. One pump is rated for 230 Watts and consumes approximately 504 kWh annually. The second pump is rated for 0.5 HP and consumes approximately 822 kWh annually.

There is an air scour that is used to assist with filter cleaning during the backwash process. The backwash process takes place once a week for approximately 30 minutes when the operator will reverse the flow of water from the water storage tank to the water treatment plant to clean the filters. The air scour consumes approximately 287 kWh annually.

There is an electric heater in the chlorine room that operates primarily in the winter heating months from October to April and consumes approximately 4,835 kWh annually.

There are some desktop computers in the water treatment plant office that are used approximately five hours per day when the operators are present. The computers consume approximately 548 kWh annually.

There is an ice maker in the process room that is used for providing ice for fishing purposes primarily. The ice maker is used occasionally during the winter months and often during the fishing season months from May to September. The ice maker consumes approximately 3,205 kWh annually.

The water dam has electric heaters that are used primarily during the winter heating months to keep the building from freezing. These electric heaters are rated for 3000 Watts and consume approximately 7,780 kWh annually.

There are backup pumps in the used for additional water intake purposes when the gravity-fed water is not available or in times of high demand. These pumps are rated for 20 HP and are estimated to consume approximately 313 kWh annually.

There is a general purpose transformer located in the water dam building that is used to step up the power to three phases whenever the high demand pumps are needed. The transformer is sized for 30 kVa and consumes approximately 13,327 kWh annually.

Figure 3.10: Transformer in the Water Dam Building

Table 3.1 shows information on the discharge pumps in each of the lift stations.

Table 3.1: Lift Station Pump Information

Lift Station	Pump Rating (HP)	Approximate Runtime	kWh Consumption
AML	7.5	6%	2,943
Hallingstad	5	12%	3,924
Community Building	7.5	30%	14,714
Bean's Point	5.5	12%	3,924

The Community Building lift station has an exhaust fan that operates approximately 80% of the time all year long and consumes approximately 328 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 Inside Passage Electric Cooperative provides electricity to the residents of Kake as well as all commercial and public facilities.

The average cost for each type of fuel used in this building is shown below in Table 3.2. This figure includes all surcharges, subsidies, and utility customer charges:

Table 3.2: Average Energy Rates by Fuel Type

Average Energy Cost	
Description	**Average Energy Cost**
Electricity	$ 0.58/kWh
#2 Oil	$ 3.75/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Kake pays approximately $38,374 annually for electricity and other fuel costs for the Kake Water Treatment Plant.

Figure 3.11 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.

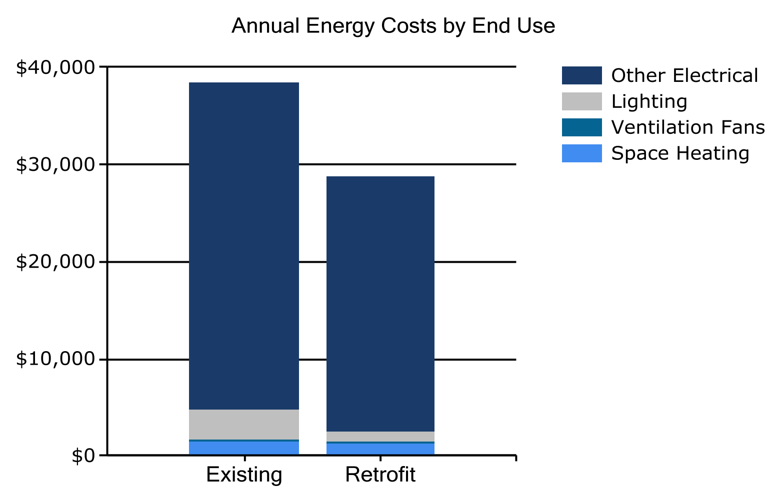

Figure 3.11: Average Energy Costs by Building Category

Figure 3.12 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.

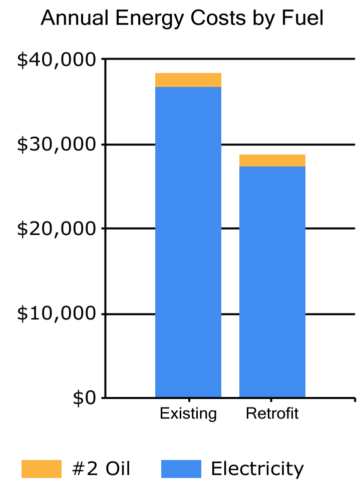

Figure 3.12: Annual Energy Costs by Fuel Type

Figure 3.13 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.

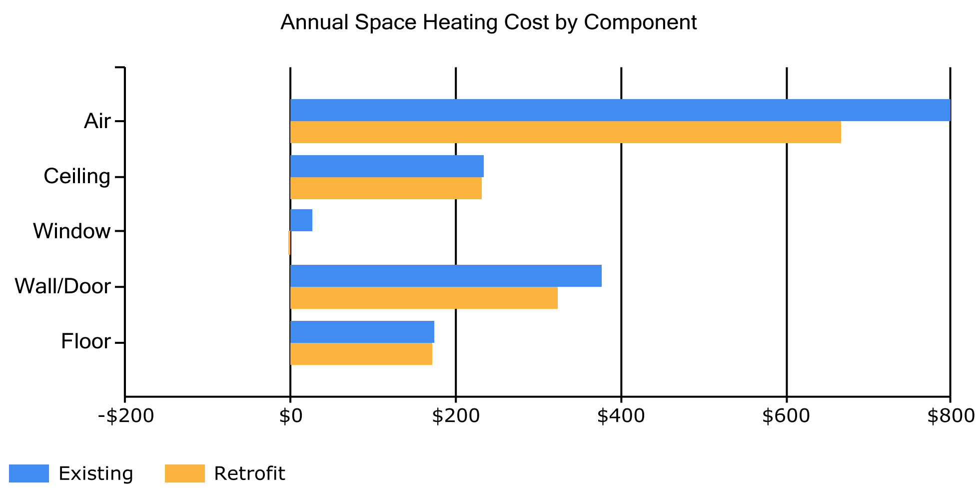

Figure 3.13: Annual Space Heating Cost by Component

Tables 3.3 and 3.4 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.

Table 3.3: Electrical Consumption by Category

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	21	15	14	11	7	2	1	1	4	8	13	19
Ventilation_Fans	2	1	2	2	2	2	2	2	2	2	2	2
Lighting	514	468	514	497	393	380	393	393	380	514	497	514
Other_Electrical	5736	5227	5736	4698	4067	4010	4144	4144	3927	4940	5551	5736

Table 3.4: Fuel Oil Consumption by Category

Fuel Oil #2 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	74	55	49	40	24	9	3	3	13	28	47	66

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 3.5 for details):

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

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

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

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Table 3.5: Kake 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	63,505 kWh	216,744	3.340	723,924
#2 Oil	411 gallons	56,717	1.010	57,284
Total		**273,461**		**781,208**
BUILDING AREA		1,792	Square Feet	
BUILDING SITE EUI		153	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		436	**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 3.6: Kake Water Treatment Plant Building Benchmarks

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**152.6**	**17.90**	**$21.41**
With Proposed Retrofits	**117.4**	**13.76**	**$16.04**
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 Kake Water Treatment Plant was modeled using AkWarm© energy use software to establish a baseline space heating energy usage. Climate data from Kake 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.

Limitations of AkWarm© Models

• The model is based on typical mean year weather data for Kake. 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: List of Energy Efficiency Measures by Economic Priority

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: Ice Maker	Relocate Ice Maker to a different location.	$1,859	$250	87.33	0.1	5,447.8
2	Other Electrical: Chlorine Room Electric Heater	Install thermostat and lower temperature to 50 deg. F.	$1,818	$2,000	10.26	1.1	3,982.1
3	Lighting: Entryway Lights	Replace with new energy-efficient LED lighting.	$128	$160	9.13	1.2	306.1
4	Setback Thermostat: Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg. F for the Water Treatment Plant space.	$727	$2,000	4.90	2.8	4,189.5
5	Other Electrical: Water Dam - Electric Heaters	Install thermostat and lower temperature to 50 deg. F.	$1,839	$5,000	4.32	2.7	5,390.8
6	Lighting: Mezzanine Lights	Replace with new energy-efficient LED lighting and add new occupancy sensor.	$177	$560	3.61	3.2	433.0
7	Lighting: Water Dam - Exterior Lights	Replace with new energy-efficient LED lighting.	$730	$2,500	3.43	3.4	2,139.2

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
8	Other Electrical: Bean Lift Station - Sewage Pumps	Repair leaks in houses to reduce pump usage (already completed).	$1,328	$5,000	3.12	3.8	3,891.0
9	Lighting: Office Lights	Replace with new energy-efficient LED lighting and add new occupancy sensor.	$141	$560	2.89	4.0	343.9
10	Lighting: Exterior Lights - HPS	Replace with new energy-efficient LED lighting.	$99	$500	2.32	5.1	290.1
11	Lighting: Process Room	Replace with new energy-efficient LED lighting and add new occupancy sensor	$472	$2,500	2.15	5.3	1,103.5
12	Lighting: Water Dam - Interior	Replace with new energy-efficient LED lighting.	$20	$160	1.50	7.9	59.7
13	Air Tightening	Add weather stripping to garage door and around side entrance.	$90	$750	1.12	8.3	521.4
14	Lighting: AML Lift Station - Incan. Lights	Replace with new energy-efficient LED lighting.	$9	$100	1.11	10.6	27.6
15	Lighting: Hallingstad Lift Station - Incan. Lights	Replace with new energy-efficient LED lighting.	$9	$100	1.11	10.6	27.6
16	Lighting: Community Building Lift Station - Incan. Light	Replace with new energy-efficient LED lighting.	$5	$50	1.11	10.6	13.8
17	Window: Office Window - South	Remove existing glass and replace with double pane glass.	$27	$493	0.96	18.1	157.5
18	Lighting: Task Lighting	Replace with new energy-efficient LED lighting.	$12	$160	0.88	12.9	28.4
19	Garage Door	Add insulating blanket to garage door.	$31	$764	0.55	24.7	178.2
20	Lighting: Chlorine Room Lighting	Replace with new energy-efficient LED lighting.	$4	$100	0.32	26.0	8.8
21	Lighting: AML Lift Station - Metal Halide Lights	Replace with new energy-efficient LED lighting.	$51	$2,000	0.30	39.0	150.5

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
22	Lighting: Hallingstad Lift Station - Metal Halide Lights	Replace with new energy-efficient LED lighting.	$51	$2,000	0.30	39.0	150.5
23	Lighting: Community Building Lift Station - Interior Lights	Replace with new energy-efficient LED lighting.	$4	$160	0.26	44.7	10.5
	TOTAL, all measures		**$9,633**	**$27,868**	**4.06**	**2.9**	**28,851.7**

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. 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 Window Measures

Rank	Location	Size/Type, Condition	Recommendation
17	Window/Skylight: Office Window - South	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 glass

Installation Cost	$493	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$27
Breakeven Cost	$473	**Savings-to-Investment Ratio**	1.0	**Simple Payback yrs**	18

Auditors Notes: The window is broken with one pane in pieces. Replace existing window with a new double-pane window to improve insulation and prevent air leakage.

4.3.2 Door Measures

Rank	Location	Size/Type, Condition	Recommendation
19	Garage Door: Garage Door - Abandoned	Door Type: Sectional, polyurethane core, 1-3/8" w/ thermal break Insulating Blanket: None Modeled R-Value: 5.3	Add insulating blanket to garage door.

Installation Cost	$764	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$31
Breakeven Cost	$417	**Savings-to-Investment Ratio**	0.5	**Simple Payback yrs**	25

Auditors Notes: The garage door is rarely used and can use more insulation to match the walls.

4.3.3 Air Sealing Measures

Rank	Location	Existing Air Leakage Level (cfm@50/75 Pa)	Recommended Air Leakage Reduction (cfm@50/75 Pa)
13		Air Tightness estimated as: 3000 cfm at 50 Pascals	Add weather stripping to garage door and around side entrance.

Installation Cost	$750	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$90
Breakeven Cost	$838	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	8

Auditors Notes: There are noticeable gaps between the side entry door and the garage door that allow air penetration into the building. Add weather stripping to these doors to prevent cool air and moisture to penetrate the building.

4.4 Mechanical Equipment Measures

4.4.1 Night Setback Thermostat Measures

Rank	Building Space	Recommendation
4	Water Treatment Plant	Implement a Heating Temperature Unoccupied Setback to 50.0 deg F for the Water Treatment Plant space.

Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$727
Breakeven Cost	$9,805	**Savings-to-Investment Ratio**	4.9	**Simple Payback yrs**	3

Auditors Notes: Adding controls for the space heater to turn itself off at a temperature set point will reduce energy use when the operator does not manually turn off the heater.

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	
3	Entryway Lights		2 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost		$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$128
Breakeven Cost		$1,461	**Savings-to-Investment Ratio**	9.1	**Simple Payback yrs**	1
Auditors Notes: The space has two fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to be replaced.						

Rank	Location		Existing Condition		Recommendation	
6	Mezzanine Lights		2 FLUOR (4) T12 4' F40T12 40W Standard StdElectronic		Replace with new energy-efficient LED lighting and add new occupancy sensor.	
Installation Cost		$560	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$177
Breakeven Cost		$2,024	**Savings-to-Investment Ratio**	3.6	**Simple Payback yrs**	3
Auditors Notes: The space has two fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to be replaced. Add an occupancy sensor to keep the lights off when the operator is not present.						

Rank	Location		Existing Condition		Recommendation	
7	Water Dam - Exterior Lights		5 MH 100 Watt StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost		$2,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$730
Breakeven Cost		$8,573	**Savings-to-Investment Ratio**	3.4	**Simple Payback yrs**	3
Auditors Notes: The building has five fixtures with a single light bulb in each fixture for a total of five light bulbs to be replaced.						

Rank	Location		Existing Condition		Recommendation	
9	Office Lights		2 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting and add new occupancy sensor.	
Installation Cost		$560	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$141
Breakeven Cost		$1,617	**Savings-to-Investment Ratio**	2.9	**Simple Payback yrs**	4
Auditors Notes: The room has two fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to be replaced.						

Rank	Location		Existing Condition		Recommendation	
10	Exterior Lights - HPS		HPS 50 Watt StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost		$500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$99
Breakeven Cost		$1,162	**Savings-to-Investment Ratio**	2.3	**Simple Payback yrs**	5
Auditors Notes: There is a single fixture with one light bulb of this type to be replaced.						

Rank	Location	Existing Condition	Recommendation
11	Process Room	5 MH 150 Watt StdElectronic	Replace with new energy-efficient LED lighting and add new occupancy sensor.

Installation Cost	$2,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$472
Breakeven Cost	$5,371	**Savings-to-Investment Ratio**	2.1	**Simple Payback yrs**	5

Auditors Notes: The room has four high bay fixtures with a single metal halide light bulb in each fixture to be replaced. The replacements should be hanging fixtures from the ceiling with two LED 17 Watt tube light bulbs in each fixture.

Rank	Location	Existing Condition	Recommendation
12	Water Dam - Interior	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic	Replace with new energy-efficient LED lighting.

Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$20
Breakeven Cost	$239	**Savings-to-Investment Ratio**	1.5	**Simple Payback yrs**	8

Auditors Notes: The space has two fixtures with two light bulbs in each fixture for a total of four light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
14	AML Lift Station - Incan. Lights	2 INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting.

Installation Cost	$100	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$9
Breakeven Cost	$111	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	11

Auditors Notes: The lift station has two single incandescent light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
15	Hallingstad Lift Station - Incan. Lights	2 INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting.

Installation Cost	$100	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$9
Breakeven Cost	$111	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	11

Auditors Notes: The lift station has two single incandescent light bulbs to be replaced.

Rank	Location	Existing Condition	Recommendation
16	Community Building Lift Station - Incan. Light	INCAN A Lamp, Std 60W	Replace with new energy-efficient LED lighting.

Installation Cost	$50	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$5
Breakeven Cost	$55	**Savings-to-Investment Ratio**	1.1	**Simple Payback yrs**	11

Auditors Notes: The lift station has a single incandescent light bulb to be replaced.

Rank	Location	Existing Condition		Recommendation	
18	Task Lighting	2 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$12
Breakeven Cost	$141	**Savings-to-Investment Ratio**	0.9	**Simple Payback yrs**	13
Auditors Notes: The space has two fixtures with four light bulbs to be replaced with two new light bulbs in each fixture for a total of four light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
20	Chlorine Room Lighting	INCAN A Lamp, Std 60W		Replace with new energy-efficient LED lighting.	
Installation Cost	$100	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$4
Breakeven Cost	$32	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	26
Auditors Notes: The room has a single incandescent 60 Watt light bulb to be replaced.					

Rank	Location	Existing Condition		Recommendation	
21	AML Lift Station - Metal Halide Lights	4 MH 150 Watt StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$51
Breakeven Cost	$603	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	39
Auditors Notes: The lift station has four exterior fixtures with a single light bulb in each fixture for a total of four light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
22	Hallingstad Lift Station - Metal Halide Lights	4 MH 150 Watt StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$51
Breakeven Cost	$603	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	39
Auditors Notes: The lift station has four exterior fixtures with a single light bulb in each fixture for a total of four light bulbs to be replaced.					

Rank	Location	Existing Condition		Recommendation	
23	Community Building Lift Station - Interior Lights	2 FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic		Replace with new energy-efficient LED lighting.	
Installation Cost	$160	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$4
Breakeven Cost	$42	**Savings-to-Investment Ratio**	0.3	**Simple Payback yrs**	45
Auditors Notes: The lift station has two fixtures with two T8 4ft. fluorescent light bulbs in each fixture for a total of four light bulbs to be replaced.					

4.5.2 Other Electrical Measures

Rank	Location		Description of Existing		Efficiency Recommendation	
1	Ice Maker		Ice Maker		Turn off ice maker and move to more appropriate location.	
Installation Cost		$250	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,859
Breakeven Cost		$21,833	**Savings-to-Investment Ratio**	87.3	**Simple Payback yrs**	0
Auditors Notes: The ice maker does not contribute to the water intake, treatment, or distribution process directly and is not needed in the water treatment plant building. This retrofit quantifies the savings to the city of moving the ice maker to a more appropriate location that may better serve fishing and other interests of the local community.						

Rank	Location		Description of Existing		Efficiency Recommendation	
2	Chlorine Room Electric Heater		Electric Heater		Install thermostat and lower temperature to 50 deg. F.	
Installation Cost		$2,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,818
Breakeven Cost		$20,530	**Savings-to-Investment Ratio**	10.3	**Simple Payback yrs**	1
Auditors Notes: Install thermostat and program a set point to 50 deg. F. This will keep the electric heater from operating more than necessary.						

Rank	Location		Description of Existing		Efficiency Recommendation	
5	Water Dam - Electric Heaters		Electric Heaters		Install thermostat and lower temperature to 50 deg. F.	
Installation Cost		$5,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,839
Breakeven Cost		$21,604	**Savings-to-Investment Ratio**	4.3	**Simple Payback yrs**	3
Auditors Notes: Install thermostat and program a set point to 50 deg. F. This will keep the electric heater from operating more than necessary.						

Rank	Location		Description of Existing		Efficiency Recommendation	
8	Bean Lift Station - Sewage Pumps		Lift Station Pumps		Repair leaks in houses to reduce pump usage (already completed).	
Installation Cost		$5,000	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$1,328
Breakeven Cost		$15,594	**Savings-to-Investment Ratio**	3.1	**Simple Payback yrs**	4
Auditors Notes: Repair leaks in houses to reduce pump usage. This was completed by the city in January. This report uses the data prior to the repair because there is no data for current performance.						

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 the City of Kake to follow up on the recommendations made in this report. Funding has been provided by to ANTHC through a Rural Alaska Village Grant to provide the 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: Kake Water Treatment Plant	**Auditor Company:** ANTHC-DEHE
Address: Water Treatment Plant	**Auditor Name:** Kevin Ulrich, Timothy Eby and Don Green
City: Kake	**Auditor Address:** 4500 Diplomacy Dr. Anchorage, AK 99508
Client Name: Kip Howard, Roy Kadake	
Client Address:	**Auditor Phone:** (907) 729-3237
	Auditor FAX:
Client Phone: (907) 785-3804	**Auditor Comment:**
Client FAX:	
Design Data	
Building Area: 1,792 square feet	**Design Space Heating Load:** Design Loss at Space: 19,065 Btu/hour with Distribution Losses: 19,065 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 29,063 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 1 people	**Design Indoor Temperature:** 60 deg F (building average)
Actual City: Kake	**Design Outdoor Temperature:** 8.7 deg F
Weather/Fuel City: Kake	**Heating Degree Days:** 8,527 deg F-days
Utility Information	
Electric Utility: Inside Passage Electric Cooperative	**Average Annual Cost/kWh:** $0.58/kWh

Annual Energy Cost Estimate					
Description	**Space Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Total Cost**
Existing Building	$1,608	$11	$3,164	$33,592	**$38,374**
With Proposed Retrofits	$1,390	$11	$1,069	$26,272	**$28,742**
Savings	$218	$0	$2,095	$7,319	**$9,633**

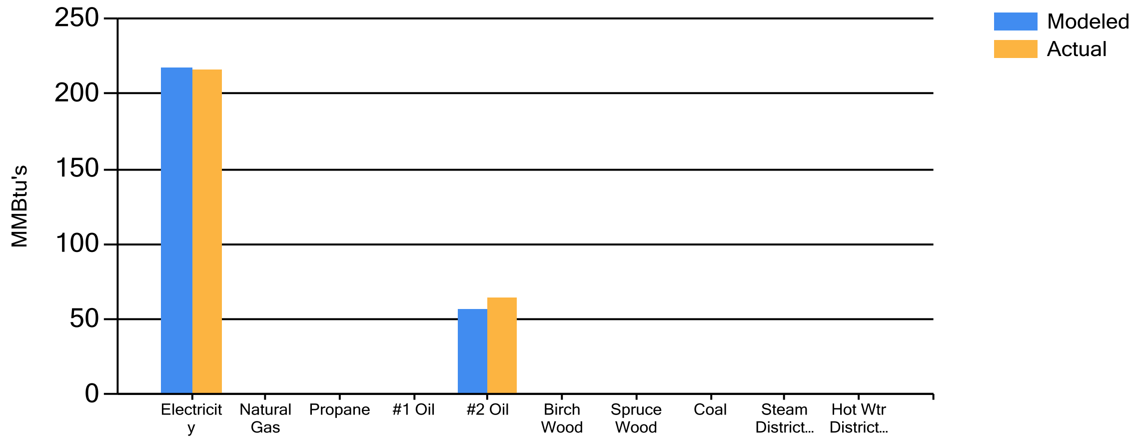
Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	152.6	17.90	$21.41
With Proposed Retrofits	117.4	13.76	$16.04

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.

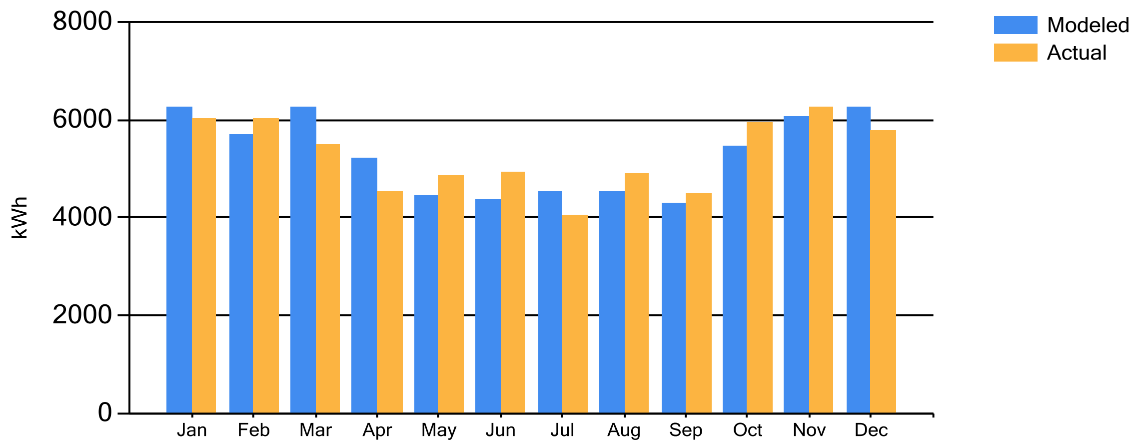
Appendix B – Actual Fuel Use versus Modeled Fuel Use

The graphs below show the modeled energy usage results of the energy audit process compared to the actual energy usage report data. The model was completed using AkWarm modeling software. The orange bars show actual fuel use, and the blue bars are AkWarm's prediction of fuel use.

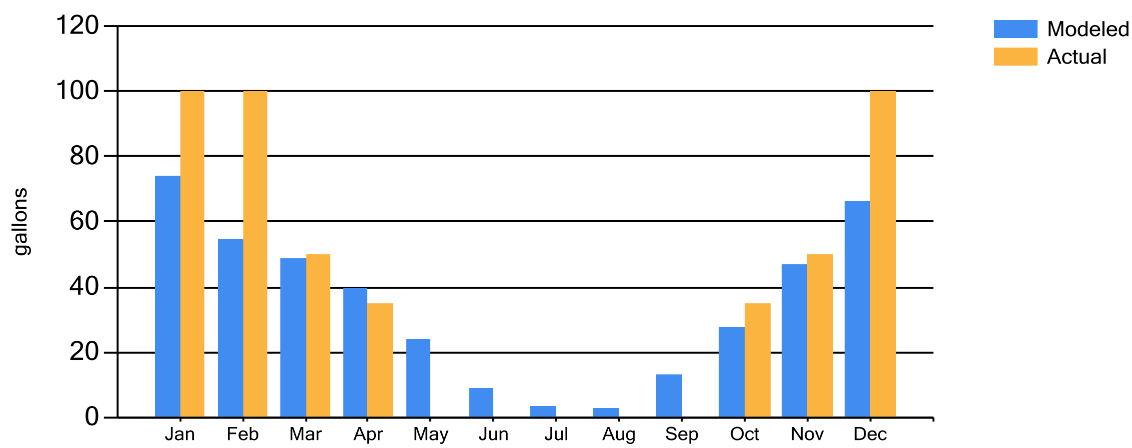
Annual Fuel Use



Electricity Fuel Use



#2 Fuel Oil Fuel Use



Appendix C - Electrical Demands

Estimated Peak Electrical Demand (kW)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current	21.2	21.2	21.2	20.0	18.9	19.0	19.0	19.0	18.9	20.1	21.2	21.2
As Proposed	17.9	17.9	17.9	17.6	17.2	17.2	17.2	17.2	17.2	17.6	17.9	17.9

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