Comprehensive Energy Audit For

Nondalton WTP

Prepared For

City of Nondalton

January 2, 2015

Prepared By:
ANTHC-DEHE
3900 Ambassador Drive, Suite 201
Anchorage, AK 99508

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PREFACE

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

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

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 2014 by the Energy Projects Group of ANTHC. This report analyzes historical energy use and identifies costs and savings of recommended energy conservation measures. Discussions of site-specific concerns, non-recommended measures, and an energy conservation action plan are also included in this report.

ACKNOWLEDGMENTS

The ANTHC Energy Projects Group gratefully acknowledges the assistance of Water Treatment Plant Operators Deacon Nikoi and Ricco Joseph, Nondalton City Administrator Katherine Trefon, and Nondalton City Clerk Gloria Trefon.

1. EXECUTIVE SUMMARY

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

The total predicted energy cost for the WTP is $68,924 per year. Electricity represents the largest piece with an annual cost of $56,924 per year. This includes $34,322 paid by the end-users and $22,602 paid by the Power Cost Equalization (PCE) program through the State of Alaska. The WTP is predicted to spend $11,989 for #1 heating oil. These predictions are based on the electricity and fuel prices at the time of the audit.

The State of Alaska PCE program provides a subsidy to rural communities across the state to lower the electricity costs and make energy in rural Alaska affordable. In Nondalton, the cost of electricity without PCE is $0.68/kWh, and the cost of electricity with PCE is $0.41/kWh.

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

Predicted Annual Fuel Use		
Fuel Use	**Existing Building**	**With Proposed Retrofits**
Electricity	114,982 kWh	41,970 kWh
#1 Oil	1,819 gallons	1,635 gallons

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

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	823.7	74.00	$89.74
With Proposed Retrofits	467.6	42.01	$41.58
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

Table 1.1 below summarizes the energy efficiency measures analyzed for the Nondalton WTP. Listed are the estimates of the annual savings, installed costs, and two different financial measures of investment return.

Table 1.1 PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR[1]**	**Simple Payback (Years)[2]**	**CO_2 Savings**
1	Other Electrical - Lift Station Pump 1 & 2	Replace lift station pump and improve controls.	$15,893	$4,000	33.46	0.3	51,897
2	Lighting - Power Retrofit: Arctic Entry Lighting	Replace with energy-efficient LED lighting.	$82	$150	8.05	1.8	236
3	Heating – Temperature Set Point: Water Tank	Lower tank heat add temperature from 45 to 42.	$601	$1,500	5.43	2.5	1,927
4	Lighting - Power Retrofit: Exterior Lighting	Replace with energy-efficient LED lighting.	$648	$2,000	4.73	3.1	2,016
5	Other Electrical - Lift Station Electric Heat	Replace lift station electric heater and improve controls	$771	$1,500	4.33	1.9	2,518
6	Other Electrical - Well Pump & Transfer Pump	Replace well pump & transfer pump and improve controls	$26,148	$100,000	3.84	3.8	59,259
7	HVAC And DHW	Shut off the boilers in the summer and improve controls.	$647	$4,000	2.79	6.2	2,074
8	Lighting - Power Retrofit: WTP Lighting	Replace with energy-efficient LED lighting.	$387	$3,000	1.90	7.8	772
	TOTAL, all measures		**$45,177**	**$116,150**	**4.82**	**2.6**	**120,702**

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 $45,177 per year, or 53.7% of the buildings' total energy costs. These measures are estimated to cost $116,150, for an overall simple payback period of 2.6 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**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Tank Heat**	**Total Cost**
Existing Building	$1,821	$0	$599	$156	$1,825	$53,620	$10,671	**$68,924**
With Proposed Retrofits	$1,785	$0	$137	$157	$902	$18,790	$9,931	**$31,937**
Savings	$36	$0	$462	-$2	$922	$34,830	$740	**$36,987**

2. AUDIT AND ANALYSIS BACKGROUND

2.1 Program Description

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

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

1) WTP: 768 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. Nondalton WTP

3.1. Building Description

The 768 square foot Nondalton Water Treatment Plant was constructed in 2012, with a normal occupancy of 0 people. The number of hours of operation for this building average 5.7 hours per day, considering all seven days of the week. The building was constructed in 1984 with a remodel completed in 2012.

The Nondalton Water Treatment Plant houses a circulating water system with two loops that provide water to the residents of the community. One loop services the south side of town and is approximately 6400ft. long. The second loop services the north side of town and is approximately 11,000ft. long.

The raw water is treated with two pressure sand filters and injected with chlorine prior to entering the 230,000 gallon water storage tank. A boost pump is used to keep the pressure up and increase the circulation rate of the system.

Nondalton has a gravity sewer system with one lift station that feeds to a sewage lagoon on the south side of town.

Description of Building Shell

The exterior walls are constructed from stressed skin panels with 2X4 stud construction and 3.5 inches of polyurethane foam insulation. There is a total of 1160 square feet of wall space. The insulation is in good condition with no significant damage from water and ice formation.

The roof of the building is a cathedral ceiling with 779 square feet of space. The roof has standard 24" framing with 2X6 construction and 5.5 inches of polyurethane foam insulation.

The floor and foundation of the building is constructed on pilings with a 2X6 lumber frame. The floor has 11 inches of polyurethane foam insulation and 768 square feet of floor space.

There are windows in the building that are double-paned with wood framing. There is approximately 8 square feet of window space.

There are three entrances to the building that each have metal doors. Two of the entrances are not insulated and have a total of 48 square feet of space. One entrance has an arctic entryway and 48 square feet of door space.

Description of Heating Plants

The Heating Plants used in the building are:

Burnham

Nameplate Information:	MPO-IQ 47-GL
Fuel Type:	#1 Oil
Input Rating:	140,700 BTU/hr
Steady State Efficiency:	84 %
Idle Loss:	1.5 %
Heat Distribution Type:	Glycol
Boiler Operation:	All Year

Burnham

Nameplate Information: Same as # 1
Fuel Type: #1 Oil
Input Rating: 140,700 BTU/hr
Steady State Efficiency: 84 %
Idle Loss: 1.5 %
Heat Distribution Type: Glycol
Boiler Operation: All Year

Laser 73

Nameplate Information: Toyotomi
Fuel Type: #1 Oil
Input Rating: 40,000 BTU/hr
Steady State Efficiency: 80 %
Idle Loss: 1.5 %
Heat Distribution Type: Air

Laser 30

Nameplate Information: Toyotomi
Fuel Type: #1 Oil
Input Rating: 20,000 BTU/hr
Steady State Efficiency: 80 %
Idle Loss: 1.5 %
Heat Distribution Type: Air

Space Heating Distribution Systems

The building is heated with a single unit heater that puts out 1000 BTU/hr. The chemical room also has radiant heating present.

Lighting

The water treatment plant main room has seven fixtures with four T8 fluorescent light bulbs in each fixture. The arctic entryway has one fixture with four T8 fluorescent light bulbs. The exterior of the building has five metal halide standard 100 Watt light bulbs.

Plug Loads

The WTP 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 is a well pump and transfer pump that combine to use 8,058 Watts. The two pumps operate 10 - 40% of the time for seven months of the year.

The lift station has a pump that uses 5,968 Watts. This pump operates constantly throughout the entire year.

There is a pressure pump present that uses 4500 Watts. The pump operates 75 - 100% of the time throughout the entire year.

The glycol is circulated by a small circulation pump that uses 87 Watts and operates constantly for nine months of the year.

There is a pump on the cold side of the water storage tank heat add system that uses 85 Watts. This pump operates constantly for nine months of the year.

There is an electric heater in the lift station that uses 1,200 Watts. The heater operates 50% of the time for nine months of the year.

There is an assortment of miscellaneous pumps and controls present in the water treatment plant that use 100 Watts and operate constantly for nine months of the year.

3.2 Predicted Energy Use

3.2.1 Energy Usage / Tariffs

The electric usage profile charts (below) represents the predicted electrical usage for the building. If actual electricity usage records were available, the model used to predict usage was calibrated to approximately match actual usage. The electric utility measures consumption in kilowatt-hours (kWh) and maximum demand in kilowatts (kW). One kWh usage is equivalent to 1,000 watts running for one hour. One KW of electric demand is equivalent to 1,000 watts running at a particular moment. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges.

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

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

Electricity: I-N-N Electric Cooperative, Inc - 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	$ 0.50/kWh
#1 Oil	$ 6.59/gallons

3.2.1.1 Total Energy Use and Cost Breakdown

At current rates, City of Nicooli pays approximately $68,924 annually for electricity and other fuel costs for the Nondalton WTP.

Figure 3.1 below reflects the estimated distribution of costs across the primary end uses of energy based on the AkWarm© computer simulation. Comparing the “Retrofit” bar in the figure to the “Existing” bar shows the potential savings from implementing all of the energy efficiency measures shown in this report.

Figure 3.1
Annual Energy Costs by End Use

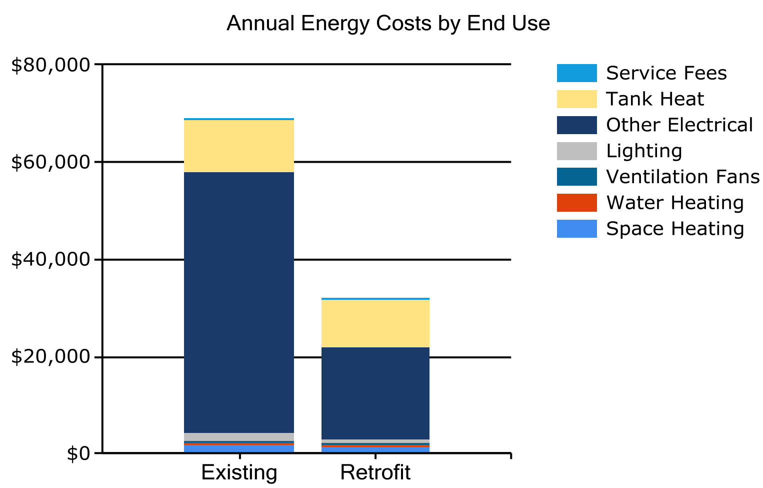


Figure 3.2 below shows how the annual energy cost of the building splits between the different fuels used by the building. The “Existing” bar shows the breakdown for the building as it is now; the “Retrofit” bar shows the predicted costs if all of the energy efficiency measures in this report are implemented.

Figure 3.2
Annual Energy Costs by Fuel Type

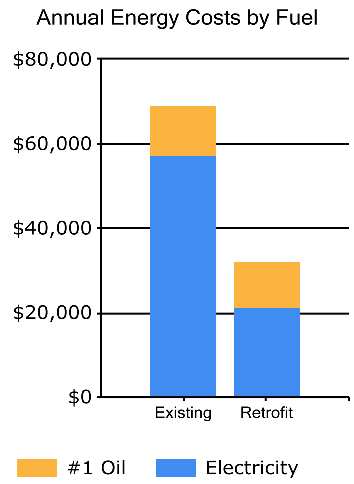
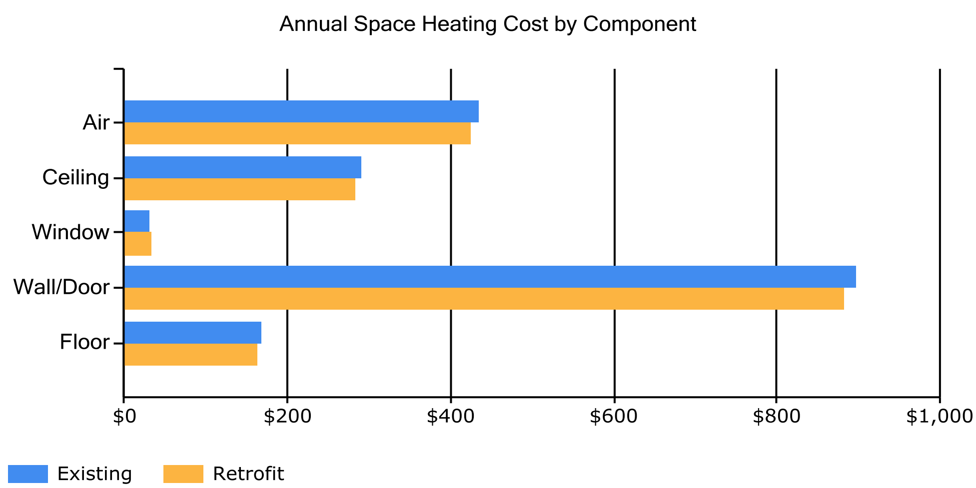


Figure 3.3 below addresses only Space Heating costs. The figure shows how each heat loss component contributes to those costs; for example, the figure shows how much annual space heating cost is caused by the heat loss through the Walls/Doors. For each component, the space heating cost for the Existing building is shown (blue bar) and the space heating cost assuming all retrofits are implemented (yellow bar) are shown.

Figure 3.3
Annual Space Heating Cost by Component



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

Electrical Consumption (kWh)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	24	21	22	19	17	17	18	18	18	19	20	25
DHW	13	12	13	12	13	18	18	18	18	13	12	13
Ventilation_Fans	27	24	27	26	27	26	27	27	26	27	26	27
Lighting	393	358	393	380	182	177	182	182	285	393	380	393
Other_Electrical	10183	9279	10183	9854	8384	7342	7587	7587	8114	10183	9854	10183
Tank_Heat	218	197	213	197	194	0	0	0	180	202	203	219

Fuel Oil #1 Consumption (Gallons)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Space_Heating	36	31	30	19	12	12	13	13	13	18	26	37
DHW	1	1	1	1	2	17	18	18	17	1	1	1
Tank_Heat	281	240	225	123	32	0	0	0	0	109	188	285

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):

Building Site EUI = (Electric Usage in kBtu + Fuel Oil Usage in kBtu) / Building Square Footage

Building Source EUI = (Electric Usage in kBtu X SS Ratio + Fuel Oil Usage in kBtu X SS Ratio) / Building Square Footage

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

Table 3.4
Nondalton WTP EUI Calculations

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	114,982 kWh	392,433	3.340	1,310,726
#1 Oil	1,819 gallons	240,144	1.010	242,545
Total		**632,577**		**1,553,272**
BUILDING AREA		768	Square Feet	
BUILDING SITE EUI		824	kBTU/Ft²/Yr	
BUILDING SOURCE EUI		2,022	**kBTU/Ft²/Yr**	
* Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued March 2011.				

Table 3.5

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	**823.7**	**74.00**	**$89.74**
With Proposed Retrofits	**467.6**	**42.01**	**$41.58**
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 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 Nondalton WTP was modeled using AkWarm© energy use software to establish a baseline space heating and cooling energy usage. Climate data from Nondalton 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 Nondalton. 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.

Table 4.1
Nondalton WTP, Nondalton, Alaska
PRIORITY LIST – ENERGY EFFICIENCY MEASURES

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR	Simple Payback (Years)	CO_2 Savings
1	Other Electrical - Combined Retrofit: Lift Station Pump 1 & 2	Replace lift station pump and improve controls.	$15,893	$4,000	33.46	0.3	51,897
2	Lighting - Power Retrofit: Arctic Entry Lighting	Replace with energy-efficient LED lighting.	$82	$150	8.05	1.8	236
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5	Other Electrical - Combined Retrofit: LS Electric Heat	Replace lift station electric heater and improve controls	$771	$1,500	4.33	1.9	2,518
6	Other Electrical - Combined Retrofit: Well Pump & Transfer Pump	Replace well pump & transfer pump and improve controls	$26,148	$100,000	3.84	3.8	59,259
7	HVAC And DHW	Shut off the boilers in the summer and improve controls.	$647	$4,000	2.79	6.2	2,074

Table 4.1 Nondalton WTP, Nondalton, Alaska PRIORITY LIST – ENERGY EFFICIENCY MEASURES							
Rank	**Feature**	**Improvement Description**	**Annual Energy Savings**	**Installed Cost**	**Savings to Investment Ratio, SIR**	**Simple Payback (Years)**	**CO_2 Savings**
8	Lighting - Power Retrofit: WTP Lighting	Replace with energy-efficient LED lighting.	$387	$3,000	1.90	7.8	772
	TOTAL, all measures		**$45,177**	**$116,150**	**4.82**	**2.6**	**120,702**

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 Mechanical Equipment Measures

4.3.1 Heating /Domestic Hot Water Measure

Rank	Recommendation				
7	Shut off the boilers in the summer and improve controls.				
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$647
Breakeven Cost	$11,174	**Savings-to-Investment Ratio**	2.8	**Simple Payback yrs**	6
Auditors Notes: Optimize the use of the existing Tekmar 261 that controls the boilers and shut off the boilers in the summer.					

4.4 Electrical & Appliance Measures

4.4.1 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.

4.4.1a Lighting Measures – Replace Existing Fixtures/Bulbs

Rank	Location	Existing Condition		Recommendation	
2	Arctic Entry Lighting	FLUOR (2) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with energy-efficient LED lighting.	
Installation Cost	$150	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$72
				Maintenance Savings (/yr)	$10
Breakeven Cost	$1,207	**Savings-to-Investment Ratio**	8.0	**Simple Payback yrs**	2
Auditors Notes: Replace 4-bulb light fixtures with LED 17 Watt Module light bulbs. This can be done by removing the ballast and direct wiring the light bulbs. The combination of the long run hours and the $0.50 per KWH cost makes this conversion cost effective.					

Rank	Location	Existing Condition		Recommendation	
4	Exterior Lighting	5 MH 100 Watt StdElectronic with Manual Switching		Replace with energy-efficient LED lighting.	
Installation Cost	$2,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$618
				Maintenance Savings (/yr)	$30
Breakeven Cost	$9,469	**Savings-to-Investment Ratio**	4.7	**Simple Payback yrs**	3
Auditors Notes: Replace exterior MH 100 Watt Magnetic light bulbs with LED 17W Module exterior wall packs with photocell control. This will allow the exterior lighting to turn on when it is dark, and shut off automatically when there it daylight. The combination of the long run hours and the $0.50 per KWH cost makes this conversion cost effective.					

Rank	**Location**	**Existing Condition**		**Recommendation**	
8	WTP Lighting	7 FLUOR (4) T8 4' F32T8 32W Standard Instant StdElectronic with Manual Switching		Replace with energy-efficient LED lighting.	
Installation Cost	$3,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$237
				Maintenance Savings (/yr)	$150
Breakeven Cost	$5,688	**Savings-to-Investment Ratio**	1.9	**Simple Payback yrs**	8
Auditors Notes: Replace 4-bulb light fixtures with LED 17 Watt Module light bulbs. This can be done by removing the ballast and direct wiring the light bulbs. The combination of the long run hours and the $0.50 per KWH cost makes this conversion cost effective.					

4.4.2 Other Electrical Measures

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
1	Lift Station Pump 1 & 2	Lift Station Pump with Manual Switching		Replace with Lift Station Pump and Improve Manual Switching	
Installation Cost	$4,000	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$15,893
Breakeven Cost	$133,841	**Savings-to-Investment Ratio**	33.5	**Simple Payback yrs**	0
Auditors Notes: The pumps casings developed holes and was allowing major leaks on the discharge side of the pumps. Replace the pumps or the casings.					

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
5	LS Electric Heat	Lift Station Electric Heat with Manual Switching		Replace with Lift Station Electric Heat and Improve Manual Switching	
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	10	**Energy Savings (/yr)**	$771
Breakeven Cost	$6,495	**Savings-to-Investment Ratio**	4.3	**Simple Payback yrs**	2
Auditors Notes: Add thermostat to electric heater in lift station and set at 40 degrees when facility is not occupied.					

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
6	Well Pump & Transfer Pump	Grundfos Well Pump & Goulds Transfer Pump with Manual Switching		Replace with Grundfos Well Pump & Goulds Transfer Pump and Improve Manual Switching	
Installation Cost	$100,000	**Estimated Life of Measure (yrs)**	20	**Energy Savings (/yr)**	$18,148
				Maintenance Savings (/yr)	$8,000
Breakeven Cost	$384,166	**Savings-to-Investment Ratio**	3.8	**Simple Payback yrs**	4
Auditors Notes: Leaks in water distribution system are resulting the use/loss of 350 gallons per person per day of treated water vs the normal consumption rate of 40-70 gallons per person per day. The savings is the result of finding and fixing the leaks. The maintenance savings is due to the significant reduction in bag filters and chlorine.					

4.4.3 Other Measures

Rank	**Location**	**Description of Existing**		**Efficiency Recommendation**	
3		Tank Heat Add Load		Lower tank heat add temperature from 45 to 42.	
Installation Cost	$1,500	**Estimated Life of Measure (yrs)**	15	**Energy Savings (/yr)**	$601
Breakeven Cost	$8,152	**Savings-to-Investment Ratio**	5.4	**Simple Payback yrs**	2
Auditors Notes: Lower the water tank heat add temperature from 45 to 42 deg. F.					

5. ENERGY EFFICIENCY ACTION PLAN

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

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

In the near future, a representative of ANTHC will be contacting both the city of Nondalton and the water treatment plant operator to follow up on the recommendations made in this audit report. A Rural Alaska Village Grant has funded ANTHC to provide the city with assistance in understanding the report and implementing the recommendations. ANTHC will work to complete the recommendations within the 2015 calendar year.

APPENDICES

Appendix A – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
PROJECT INFORMATION	**AUDITOR INFORMATION**
Building: Nondalton WTP	**Auditor Company:** ANTHC-DEHE
Address: PO Box 89	**Auditor Name:** Carl Remley
City: Nondalton	**Auditor Address:** 3900 Ambassador Drive, Suite 201 Anchorage, AK 99508
Client Name: Deacon Nikoi and Ricco Joseph	
Client Address: PO Box 89 Nondalton, AK 99640	**Auditor Phone:** (907) 729-3543
	Auditor FAX:
Client Phone: (907) 294-2235	**Auditor Comment:** Cody Ulig joined me to train operators
Client FAX:	
Design Data	
Building Area: 768 square feet	**Design Space Heating Load:** Design Loss at Space: 6,721 Btu/hour with Distribution Losses: 7,468 Btu/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 11,384 Btu/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
Typical Occupancy: 0 people	**Design Indoor Temperature:** 60 deg F (building average)
Actual City: Nondalton	**Design Outdoor Temperature:** -19.1 deg F
Weather/Fuel City: Nondalton	**Heating Degree Days:** 11,130 deg F-days
Utility Information	
Electric Utility: I-N-N Electric Cooperative, Inc - Commercial - Sm	**Natural Gas Provider:** None
Average Annual Cost/kWh: $0.495/kWh	**Average Annual Cost/ccf:** $0.000/ccf

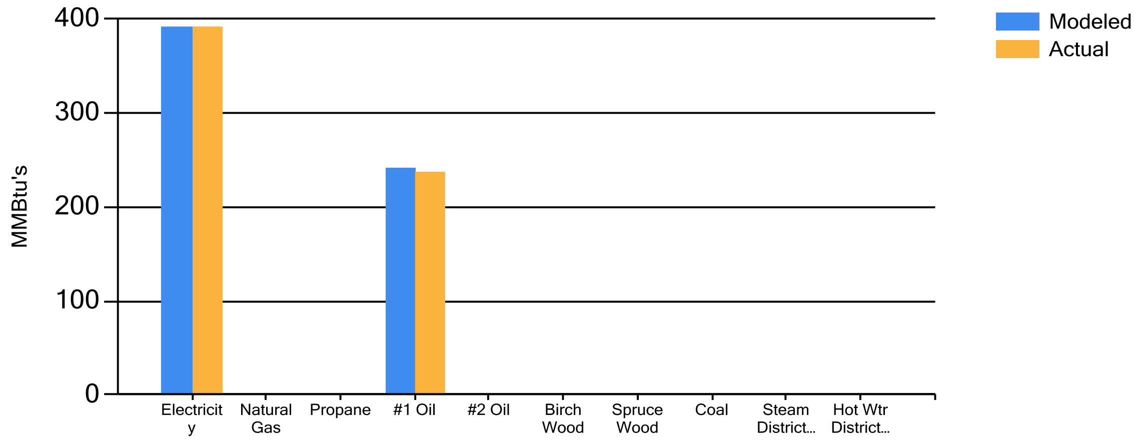
Annual Energy Cost Estimate									
Description	**Space Heating**	**Space Cooling**	**Water Heating**	**Ventilation Fans**	**Lighting**	**Other Electrical**	**Tank Heat**	**Service Fees**	**Total Cost**
Existing Building	$1,821	$0	$599	$156	$1,825	$53,620	$10,671	$234	**$68,924**
With Proposed Retrofits	$1,785	$0	$137	$157	$902	$18,790	$9,931	$234	**$31,937**
Savings	$36	$0	$462	-$2	$922	$34,830	$740	$0	**$36,987**

Building Benchmarks			
Description	**EUI (kBtu/Sq.Ft.)**	**EUI/HDD (Btu/Sq.Ft./HDD)**	**ECI ($/Sq.Ft.)**
Existing Building	823.7	74.00	$89.74
With Proposed Retrofits	467.6	42.01	$41.58
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area. EUI/HDD: Energy Use Intensity per Heating Degree Day. ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.			

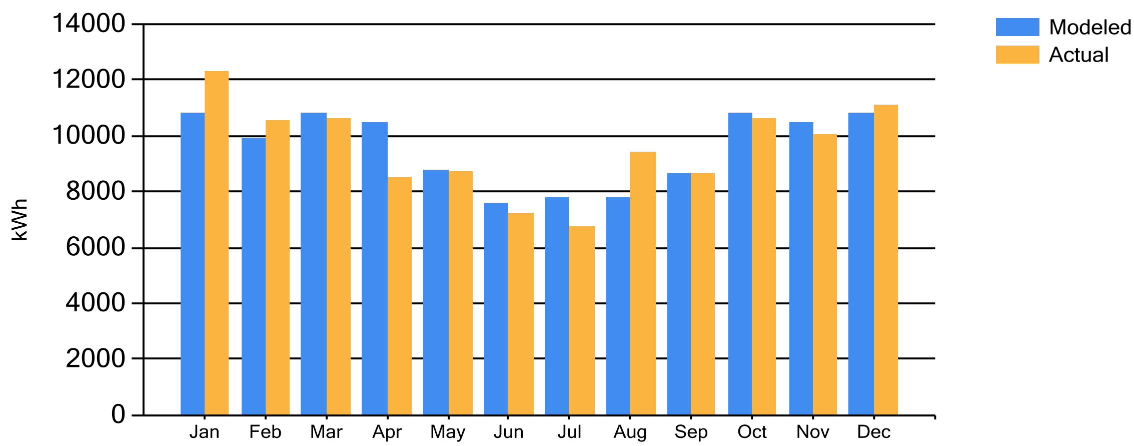
Appendix B – Actual Fuel Use versus Modeled Fuel Use

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

Annual Fuel Use



Electricity Fuel Use



#1 Fuel Oil Fuel Use