



# Comprehensive Energy Audit For Solomon Bed and Breakfast



Prepared For  
**Village of Solomon**

**August 20, 2018**

**Prepared By: Kelli Whelan, Cody Uhlig**

**Alaska Native Tribal Health Consortium  
4500 Diplomacy Drive  
Anchorage, AK 99508**

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## **PREFACE**

The purpose of this report is to provide guidance to reduce operating costs and enhance the sustainability of this facility. The report assesses the current energy usage of the facility, provide options for reducing the amount of energy used, and evaluate the cost versus benefit of each option.

Discussions of site-specific concerns, financing options, general facility information, and an energy efficiency action plan are also included in this report.

## **ACKNOWLEDGMENTS**

The Alaska Native Tribal Health Consortium (ANTHC) Rural Energy Initiative gratefully acknowledges the assistance of Deilah Johnson, IGAP Coordinator for the Village of Solomon.

## **LIMITATIONS OF THIS STUDY**

The building modeling software AkWarm© was used to create a virtual representation of the Solomon Bed and Breakfast. The model is then used to test the cost effectiveness of different energy efficiency measures (EEMs) like LED lighting and insulation improvements. The AkWarm© software calculates the annual cost savings and payback period for the investment, and then ranks all EEMs based on their payback period.

There are limitations using this software, which may affect the accuracy of the EEMs cost savings. This report should serve as a guide when deciding which EEMS to pursue further. A certified professional in that field should verify all EEMs and installation costs before construction begins.

## OVERVIEW

This report was prepared for the Village of Solomon Council. The scope of the audit focused on the Solomon Bed and Breakfast. The scope of this report is a comprehensive energy study, which included an analysis of building shell, interior and exterior lighting systems, heating and ventilation systems, and other electrical loads. Data was collected during an on-site survey and through interviews with members of the Village of Solomon.

The Solomon Bed and Breakfast has about 3,060 square feet of total floor space. The building is a historical site, built in 1940 as the local public school. Today, the building serves both as a community center and a bed and breakfast.

## ENERGY BASELINE

Based on unsubsidized electricity and fuel oil prices in effect at the time of the audit, the total predicted energy costs are about \$11,232 per year. This includes \$2,887 for electricity, which is generated on site, and an estimated \$8,345 for #1 fuel oil. The cost of electricity varies depending on the price of diesel in Nome and any annual maintenance costs. See the “Description of Diesel Generators” section for electrical cost calculations and assumptions.

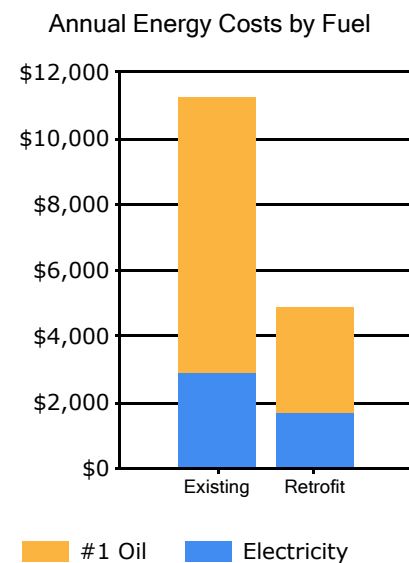
The State of Alaska Power Cost Equalization (PCE) program provides a subsidy to rural communities across the state to lower electricity costs and make energy affordable in rural Alaska. The Solomon Bed and Breakfast does not receive a PCE subsidy.

Table 1 lists the predicted annual energy usage before and after the proposed retrofits for the Solomon Bed and Breakfast.

**Table 1: Predicted Annual Energy Use for the Solomon Bed and Breakfast**

Predicted Annual Fuel Use			
Fuel Use	Existing Building	With Proposed Retrofits	Total Savings
Electricity	3,955 kWh	2,345 kWh	1,610 kWh
#1 Oil	1,739 gallons	658 gallons	1,081 gallons

**Annual Energy Costs by Fuel Type**



## PROPOSED ENERGY EFFICIENCY MEASURES (EEM)

Table 2 below summarizes the energy efficiency measures analyzed for the Solomon Bed and Breakfast. Listed are the estimates of the annual savings, installed costs, and two different financial measures of

investment return: the Savings Investment Ratio (SIR) and the retrofits' Simple Payback. Green highlighted cells are high priority measures, yellow are medium priority, and orange highlighted cells are the lowest priority recommendations.

**Table 2: Priority List – Energy Efficiency Measures**

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
1	Lighting: Hallways	Replace all incandescent bulbs in the overhead fixtures with energy efficient LED equivalents.	\$21 + \$14 Maint. Savings	\$13	20.48	0.4
2	Lighting: Smaller Shared Bathroom, Bedroom #2 private bath, Bedroom #3 private bath	Replace all 100 W incandescent bulbs in the bathroom vanities with energy efficient LED equivalents.	\$14 + \$27 Maint. Savings	\$26	12.40	0.6
3	Shell Improvements: Attic	Install R-38 loose-fill insulation in attic.	\$2,606	\$5,661	10.55	2.2
4	Lighting: Main Shared Bathroom, Bedroom #3 private bath	Replace all 40 W incandescent bulbs in the bathroom vanities with energy efficient LED equivalents.	\$2 + \$13 Maint. Savings	\$13	9.15	0.8
5	Lighting: Bedroom #1, #2, #4, and #5	Replace all 60 W incandescent bulbs with energy efficient LED equivalents.	\$8 + \$21 Maint. Savings	\$26	8.63	0.9
6	Lighting: Dining/Sitting Room	Replace the compact fluorescent bulbs in the ceiling fans with energy efficient LED equivalents.	\$1 + \$24 Maint. Savings	\$26	7.56	1.0
7	Lighting: Kitchen	Replace all incandescent bulbs with energy efficient LED equivalents.	\$7 + \$10 Maint. Savings	\$24	5.65	1.4
8	Lighting: Bedroom #1 and #6	Replace all 40 W incandescent bulbs with energy efficient LED equivalents.	\$3 + \$13 Maint. Savings	\$24	4.93	1.6
9	Lighting: Tool Room	Replace all incandescent bulbs with energy efficient LED equivalents.	\$0 + \$7 Maint. Savings	\$12	4.75	1.6
10	Lighting: Exterior Lighting	Replace all incandescent bulbs with energy efficient LED equivalents.	\$0 + \$7 Maint. Savings	\$12	4.75	1.6

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
11	Shell Improvement: Walls	<p>Have the walls inspected for faulty wiring, asbestos, and lead paint.</p> <p>Consult with a historical building preservationist on the best way to insulate the walls while maintaining structural integrity, and minimizing the growth of mold and rot.</p> <p>Fill gaps between studs with R-13 equivalent insulation.</p>	\$3,120	\$19,823	3.61	6.4
12	Other Electrical: Small Kitchen Appliance	Turn off coffeemaker after brewing. Keep fresh coffee in an insulated carafe.	\$7	\$40	1.37	6.0
13	Lighting: Classroom	Replace the compact fluorescent bulbs in the overhead fixtures and ceiling fans with energy efficient LED equivalents.	\$1 + \$3 Maint. Savings	\$26	1.21	6.4
14	Lighting: Hallways	Replace the compact fluorescent bulbs in the overhead fixtures with energy efficient LED equivalents.	\$2 + \$5 Maint. Savings	\$45	1.21	6.4
15	Lighting: Main Shared Bathroom, Bedroom #1 private bath, Smaller Shared Bathroom, Bedroom #3 private bath	Replace the compact fluorescent bulbs in the overhead fixtures with energy efficient LED equivalents.	\$1 + \$8 Maint. Savings	\$77	0.92	8.5
16	Lighting: Bedroom #1, #4, #3, #2, #5, #6	Replace the compact fluorescent bulbs in the overhead fixtures with energy efficient LED equivalents.	\$1 + \$6 Maint. Savings	\$58	0.92	8.5

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
17	Heating, Ventilation, and Domestic Hot Water	<p>Clean and tune furnaces, oil stoves, and hot water heater.</p> <p>Install foil faced fiberglass batt or insulating board around the exterior of all ductwork in the building, especially in the attic.</p> <p>Install a hot water tank blanket to reduce heat loss.</p> <p>Install faucet aerators and low flow showerheads to reduce cold and hot water consumption.</p>	\$433	\$11,231	0.65	25.9
18	Lighting: Exterior Lighting	Replace the compact fluorescent bulbs with energy efficient LED equivalents.	\$0 + \$5 Maint. Savings	\$95	0.43	18.0
19	Exterior Door: Dining/Sitting Room	Install an insulated storm door.	\$8	\$366	0.39	43.3
20	Exterior Door: Front Door	Install an insulated storm door.	\$9	\$371	0.39	43.3
21	Exterior Door: Classroom	Install two insulated storm doors.	\$15	\$639	0.39	43.3
22	Lighting: Janitor Closets, Storage Room, Furnace Room, Linen Closet	Replace the compact fluorescent bulbs with energy efficient LED equivalents.	\$-1 + \$4 Maint. Savings	\$71	0.37	20.9
23	Air Sealing	<p>Install weather-stripping around all windows and exterior doors (if the doors. Replace the sweeps at the bottom of all exterior doors. Re-caulk windows as needed.</p> <p>Install insulating gaskets behind the electrical socket and light switch faceplates on exterior walls. Energy savings reflect a 5% reduction in draft.</p>	\$50	\$1,500	0.30	30.3
24	Exterior Door: Bedroom #1	Add insulated storm door.	\$2	\$290	0.13	126.2
25	Exterior Door: Bedroom #3	Install an insulated storm door.	\$3	\$366	0.13	126.3
26	Exterior Door: Bedroom #2	Install an insulated storm door.	\$3	\$366	0.13	126.1

Rank	Feature	Improvement Description	Annual Energy Savings	Installed Cost	Savings to Investment Ratio, SIR <sup>1</sup>	Simple Payback (Years) <sup>2</sup>
27	Exterior Door: Bedroom #4	Install an insulated storm door.	\$3	\$369	0.13	126.3
28	Exterior Door: Tool Room	Install an insulated storm door.	\$3	\$369	0.13	126.2
29	Window: Dining/Sitting Room	Install single pane storm windows on the exterior of all windows.	\$29	\$6,391	0.08	223.2
30	Window: Bedroom #3 Private Bath	Install a single pane storm window on the exterior of one window.	\$2	\$508	0.06	266.5
31	Window: Bedroom #3	Install single pane storm windows on the exterior of all not south-facing windows.	\$3	\$856	0.06	266.9
32	Window: Kitchen	Install a single pane storm window on the exterior of one window.	\$3	\$742	0.06	267.2
33	Window: Bedroom #3	Install a single pane storm window on the exterior of the south-facing window.	\$1	\$856	0.02	719.7
34	Window: Bedroom #4	Install single pane storm windows on the exterior of the windows.	\$2	\$1,745	0.02	726.1
35	Window: Storage Room (off of the Dining/Sitting Room)	Install two single pane storm windows on the exterior of the windows.	\$3	\$2,130	0.02	732.8
<b>TOTAL for all measures</b>			<b>\$6,364 + \$166 Maint. Savings</b>	<b>\$55,166</b>	<b>2.58</b>	<b>8.4</b>
<b>TOTAL for all high and medium priority measures</b>			<b>\$5,792 + \$143 Maint. Savings</b>	<b>\$25,769</b>	<b>5.16</b>	<b>4.3</b>

**Table Notes:**

<sup>1</sup> Maintenance savings were calculated by determining the approximate number and cost of fluorescent bulbs that would need to be replaced over the lifetime of an equivalent LED bulb, and then adding that subtotal to the cost of labor for changing each bulb. The total was divided over the lifespan of the LED equivalent bulb. Note: the LED lifespan is capped at 30 years.

A value of \$25 per hour was estimated for local labor. The length of time for changing each bulb was estimated at 10 minutes.

<sup>2</sup> 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.

<sup>3</sup> 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.

### **Additional Recommendations (not included in Table 2)**

Thermal curtains: Installing thermally insulating or heavy curtains may reduce air/heat loss through the windows. Close curtains when a room is not in use.

Shrink wrap plastic: Install plastic around the windows to reduce draft during the winter.

Energy efficient appliances: Consider purchasing a smaller, Energy Star rated refrigerator. Use the current refrigerator only as needed.

Energy conservation: Hand dry or allow dishes to air dry instead of using the dishwasher's heated dry cycle.

# FACILITY DESCRIPTION

## **Building Occupancy Schedule**

The approximately 3,060 square foot Solomon Bed and Breakfast was constructed in 1940, originally the school for the Village of Solomon. The building was remodeled, and reopened as a bed and breakfast and community center in 2007. The Solomon Bed and Breakfast is open seasonally starting in late May to early June, and closing in mid-September. Occasionally, the building is opened in February for the Iditarod, depending on demand. The Village of Solomon hosts its annual Youth Culture Camp at the bed and breakfast for one week during August. For modeling purposes, the Solomon Bed and Breakfast was assumed to be constantly occupied by about five people during operating hours.

## **Description of Building Shell**

The exterior walls were assumed to be constructed of 2x4-timber framing with wooden siding. The building walls are currently uninsulated.

The roof of the Solomon Bed and Breakfast is constructed with standard trusses. The building has a cold roof with about two to three inches of loose fill insulation above the ceiling.

The Solomon Bed and Breakfast is built above grade on four-foot wooden pilings. The floor is insulated with R-38 fiberglass batt and 1" to 1.5" rigid foam board on the exterior.

Typical windows throughout the building are low-E, double pane glass filled with N<sub>2</sub>/Argon gases. Thirteen of the 27 windows have single pane storm windows on the exterior. Eleven windows are south facing.

All exterior doors are insulated fiberglass/vinyl doors. None of the exterior doors had storm doors at the time of the site visit.

## **Description of Diesel Generators**

### **Diesel Generator**

Nameplate Information:	Northern Lights model NL378K-10KW
Fuel Type:	#1 Oil
Input Rating:	0.62 gal/hr. (estimated)
Steady State Efficiency:	33 % (estimated)
Average Load:	5 kW

The Solomon Bed and Breakfast generates its own power on site using a 10 kW diesel generator. Based on interviews with tribal members, the generator is usually running at half capacity. An equivalent Northern Lights generator (model NL843NW4) uses 0.62 gallons of diesel per hour at half load. Most diesel generators are 33% efficient: one-third of the fuel intake goes to producing electricity, one-third goes out through the exhaust, and the last third is lost as heat through the generator's radiators.

Additionally, the Village of Solomon hires a generator maintenance specialist once per year. The specialist charges \$260 per tune up, plus the cost of new filters and oil (approximately \$100 per year). This equates to \$0.14 per hour in maintenance expenses.

The price for #1 fuel oil in Nome was \$4.80 per gallon at the time of the site visit. Given the estimated consumption above and the maintenance costs, the cost per kilowatt-hour was about \$0.73 in June 2018. See the calculations below for reference.

$$\left(\frac{0.62 \text{ gallons}}{5 \text{ kW} * \text{hour}}\right) = \left(\frac{0.124 \text{ gallons}}{\text{kW} * \text{hour}}\right)$$

$$\left[\left(\frac{0.124 \text{ gallons}}{\text{kW} * \text{hour}}\right) * \left(\frac{\$4.80}{\text{gallon}}\right)\right] + \left(\frac{\$0.14}{\text{hour}}\right) = \$0.73/\text{kWh} \text{ (estimated)}$$

### **Description of Heating Systems**

The heating systems used in the building are:

#### **Oil-fired Forced Air Furnace (east wing)**

Nameplate Information:	Lennox Industries, Inc. model 023Q2/3-70/90-5B
Fuel Type:	#1 Oil
Input Rating:	69,000 BTU/hr.
Steady State Efficiency:	81 % (estimated)
Idle Loss:	0 %
Heat Distribution Type:	Air

#### **Oil-fired Forced Air Furnace (west wing)**

Nameplate Information:	Lennox Industries, Inc. model 023Q2/3-70/90-5B
Fuel Type:	#1 Oil
Input Rating:	69,000 BTU/hr.
Steady State Efficiency:	81 % (estimated)
Idle Loss:	0 %
Heat Distribution Type:	Air

#### **Oil-fired Stove (Classroom)**

Nameplate Information:	Warnock Hersey Petit Jurassien
Fuel Type:	#1 Oil
Input Rating:	30,622 BTU/hr.
Steady State Efficiency:	76 % (estimated)
Idle Loss:	1.5 %
Heat Distribution Type:	Air
Notes:	Used infrequently.

### **Oil-fired Stove (Dining/Sitting Room)**

Nameplate Information:	Warnock Hersey Petit Jurassien
Fuel Type:	#1 Oil
Input Rating:	30,622 BTU/hr.
Steady State Efficiency:	76 % (estimated)
Idle Loss:	1.5 %
Heat Distribution Type:	Air
Notes:	Used infrequently.

### **Space Heating Distribution Systems**

Heat is produced and distributed throughout the Solomon Bed and Breakfast by two forced air furnaces, one in each wing of the building. The ductwork in the furnace rooms are uninsulated; the ductwork in the attic was assumed to be uninsulated as well.

Two oil-fired space heaters are used infrequently. One is located in a front common room (called the Classroom), and the second is located in the main dining and sitting room.

The Solomon Bed and Breakfast is not heated outside of operating hours. Unfortunately, AkWarm does not model seasonal building shut downs. The seasonal shut down was approximated in the model by setting the interior building temperature to 32° F from mid-September to late May.

### **Domestic Hot Water System**

#### **Oil-fired Hot Water Heater**

Nameplate Information:	Bock model 51E with Bock Burner
Fuel Type:	#1 Oil
Input Rating:	152,000 BTU/hr.
Steady State Efficiency:	80 % (estimated)
Idle Loss:	0 %
Heat Distribution Type:	Water
Boiler Operation:	Typically June through mid-September

Hot water is produced in an oil-fired hot water heater. The tank was assumed to have built-in R-10 insulation, and has a capacity of 50 gallons.

The building's hot and cold water systems are drained completely when the bed and breakfast is closed for the winter. This seasonal hot water use was approximated in AkWarm by limiting hot water production to three months per year.

### **Description of Building Ventilation Systems**

In addition to the ducted heating system, the Solomon Bed and Breakfast ventilation system four exhaust fans: one above the range and oven in the Kitchen, and three bathroom exhaust fans. All four fans were

assumed to be used about a half an hour per day when the building is in operation (June through mid-September).

### **Lighting**

There are about 51 light fixtures inside and on the exterior of the building. The lights use an estimated 163 kWh annually.

**Table 3: Lighting in the Solomon Bed and Breakfast**

Lighting	Number of Bulbs	Fixture Type	Location(s)
100 W Incandescent Bulbs	12	Surface mounted lighting, bathroom vanities	Classroom, hallways, smaller shared bathroom, Room #2 private bath, Room #3 private bath
60 W Incandescent Bulbs	6	Surface mounted lighting, table lamps	Kitchen; bedrooms #1, #2, #4, and #5
40 W Incandescent Bulbs	4	Table lamps, bathroom vanities	Bedrooms #1 and #6; main shared bathroom; Room #3 private bath
Compact Fluorescent Bulbs	52	Surface mounted lighting, ceiling fans, bathroom vanities, exterior lighting	Classroom, hallways, dining/sitting room; bedrooms #1, #2, #3, #4, #5, and #6; janitor and storage closets; furnace rooms; main shared bathroom; smaller shared bathroom; Rooms #1 and #3 private baths; exterior surface mounted lighting
Metal Halide	2	Kitchen hood	Kitchen

### **Major Equipment**

Below is a list of the major equipment in the Solomon Bed and Breakfast. The appliances and equipment use an estimated 1,141 kWh annually.

**Table 4: Major Appliances and Equipment in the Solomon Bed and Breakfast**

Equipment	Rating (Watts)	Annual Usage (kWh)
Amana Bottom Freezer Refrigerator	2.85 kWh per day	299
Bosch Dishwasher	1,440	77
GE Microwave	1,400	22.5
Proctor Silex 12-cup Coffee Maker	900 (full load)	36.1

Small Kitchen Appliances	1,560 (total)	20.9
Dell Desktop Computer and Monitor	925 (total)	593.9
Satellite Modem	75	192.6
Wireless Router	30	77
Submersible Well Pump	373 (estimated)	20

## PROJECT FINANCING

The total estimated cost of the recommended EEM's is \$55,166. The payback for the implemented EEM's is approximately 8.4 years. ANTHC is willing to assist the Village of Solomon with acquiring funds to complete the scope of work recommended in this energy audit.

There are several options for financing energy efficiency projects within the State of Alaska. These include the use of grants, loans, and other funding opportunities. Below is some information on potential funding opportunities.

**Energy Efficiency Revolving Loan Program** – This is a loan administered by the Alaska Housing Finance Corporation (AHFC) for use by any applicant who is also the owner of the building where the work will take place. It provides a loan for permanent energy-efficiency projects with a completion window of one year.

**Sustainable Energy Transmission and Supply Program** – This is a loan administered by the Alaska Energy Authority (AEA) for a government, business, or other organized body of people. It provides a loan for energy-efficiency or power transmission or distribution projects.

**USDA-RD Communities Facilities Direct Loan & Grant Program** - This is a loan or grant provided by the US Department of Agriculture – Rural Development (USDA-RD) for any essential community facility in a rural area. It provides a loan or grant to develop essential community facilities with upgrades or equipment for improvement.

## MEASUREMENT AND VERIFICATION

The actual results of these recommendations can be measured by collecting and monitoring energy use. This information is available on the monthly bills provided by the local electric utility and the local fuel oil supplier. Collecting data and performing a historical comparison is the simplest method of validating the energy and cost savings seen by the measures. Additionally, active remote monitoring systems are available that can collect and store data regarding energy and fuel usage. These systems allow the user to track the usage in real time and can be shared more easily with partners across the state.

## **APPENDICES**

### ***Appendix A – Scanned Energy Billing Data***

1. #1 Fuel Oil Billing Data

Usage is estimated at 2,000 gallons to 3,000 gallons per season.

### ***Appendix B – Performance Results***

1. Thermal Imaging/Blower Door Test

A blower door test at 50 Pascal was conducted on 6/2/2018. The total CFM for the building was 2,000 CFM.

## Appendix C – Energy Audit Report – Project Summary

ENERGY AUDIT REPORT – PROJECT SUMMARY	
General Project Information	
<b>PROJECT INFORMATION</b>	<b>AUDITOR INFORMATION</b>
<b>Building:</b> Solomon Bed and Breakfast	<b>Auditor Company:</b> Alaska Native Tribal Health Consortium
<b>Address:</b> Mile 34 Nome/Council Hwy.	<b>Auditor Name:</b> Kelli Whelan
<b>City:</b> Nome	<b>Auditor Address:</b> 4500 Diplomacy Drive
<b>Client Name:</b> Deilah Johnson, Elizabeth Johnson	Anchorage, AK 99508
<b>Client Address:</b> Box 2053 Nome, AK 99762	<b>Auditor Phone:</b> (907) 729-3723
<b>Client Phone:</b> (907) 443-2403	<b>Auditor FAX:</b> (907) 729-3509
<b>Client FAX:</b>	<b>Auditor Comment:</b>
<b>Design Data</b>	
<b>Building Area:</b> 3,060 square feet	<b>Design Space Heating Load:</b> Design Loss at Space: 143,996 BTU/hour with Distribution Losses: 169,407 BTU/hour Plant Input Rating assuming 82.0% Plant Efficiency and 25% Safety Margin: 258,242 BTU/hour Note: Additional Capacity should be added for DHW and other plant loads, if served.
<b>Typical Occupancy:</b> 5 people	<b>Design Indoor Temperature:</b> 67° F (building average)
<b>Actual City:</b> Nome	<b>Design Outdoor Temperature:</b> -26.1° F
<b>Weather/Fuel City:</b> Nome	<b>Heating Degree Days:</b> 13,764° F-days
<b>Utility Information</b>	
<b>Electric Utility:</b> Self-generated Power (diesel)	<b>Average Annual Cost/kWh:</b> \$0.73/kWh (as of June 2018)

Annual Energy Cost Estimate							
Description	Space Heating	Water Heating	Ventilation Fans	Lighting	Refrigeration	Other Electrical	Total Cost
Existing Building	\$9,804	\$230	\$29	\$119	\$218	\$833	\$11,232
With Proposed Retrofits	\$3,569	\$176	\$29	\$51	\$218	\$824	\$4,868
Savings	\$6,234	\$54	\$0	\$67	\$0	\$9	\$6,364

Building Benchmarks			
Description	EUI (kBtu/sq. ft.)	EUI/HDD (Btu/sq. ft./HDD)	ECI (\$/sq. ft.)
Existing Building	79.4	5.77	\$3.67
With Proposed Retrofits	31.0	2.25	\$1.59

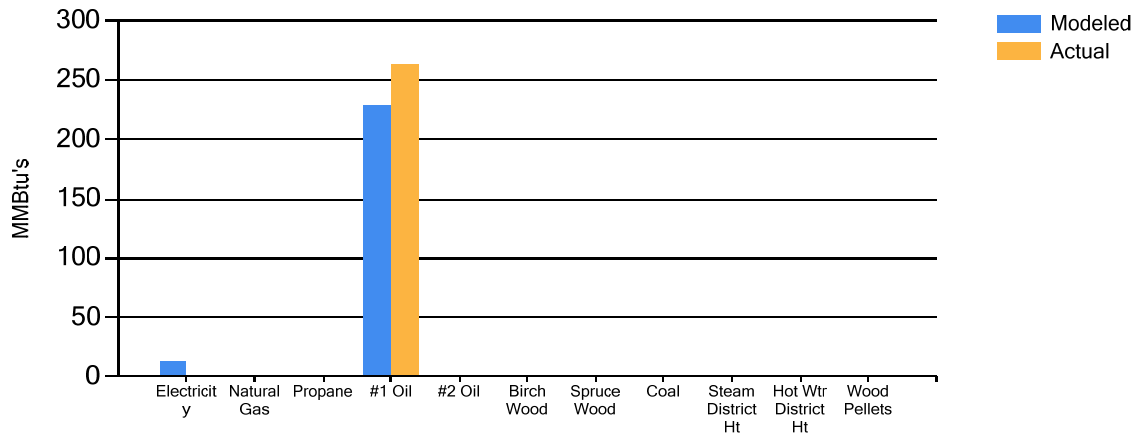
EUI: Energy Use Intensity - The annual site energy consumption divided by the structure's conditioned area.  
EUI/HDD: Energy Use Intensity per Heating Degree Day.  
ECI: Energy Cost Index - The total annual cost of energy divided by the square footage of the conditioned space in the building.



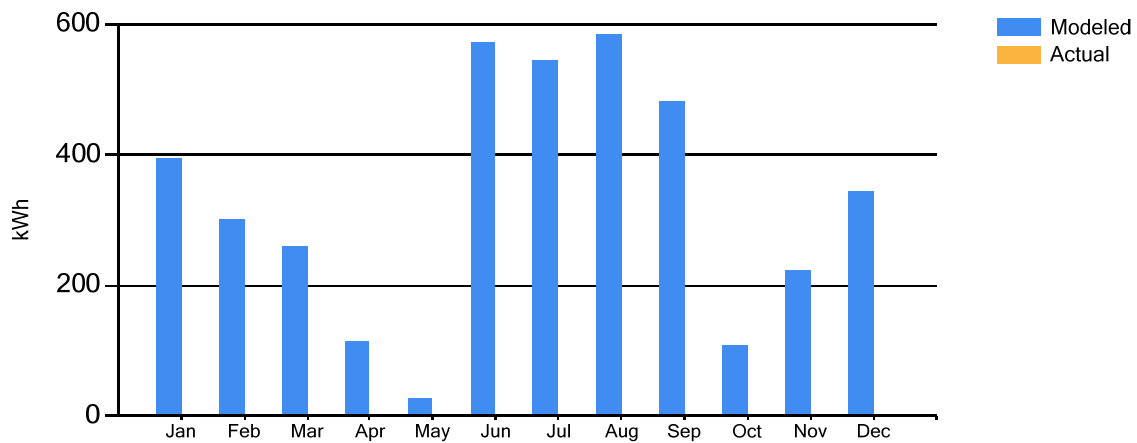
## Appendix D – Actual Fuel Use versus Modeled Fuel Use

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.

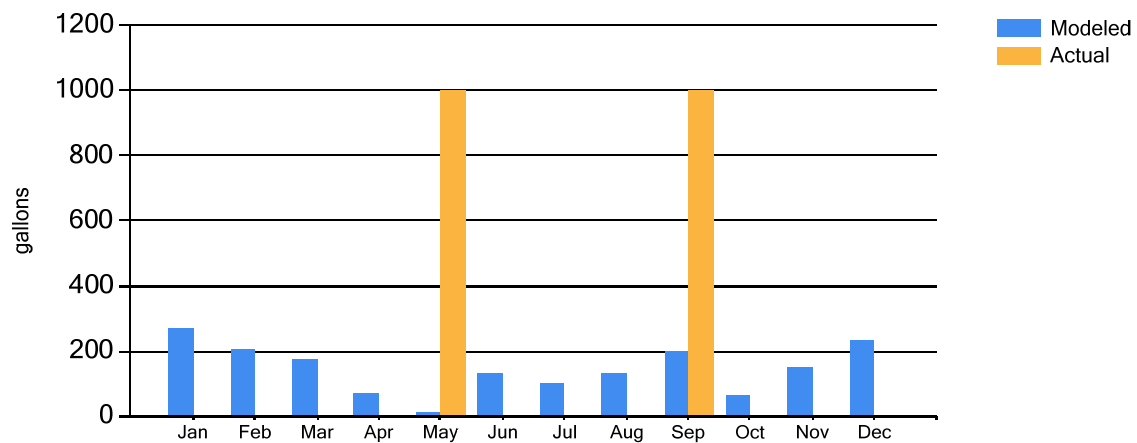
### Annual Fuel Use



### Electricity Fuel Use



### #1 Fuel Oil Fuel Use



## Appendix E - EUI Calculation Details

The Solomon Bed and Breakfast generates electricity on-site using a 10 kW generator. Fuel is delivered twice per year from Nome.

The average cost for each type of fuel used in this building is shown in Table D-1 below. This figure includes all surcharges, subsidies, and utility customer charges:

**Table D-1: Energy Cost Rates for each Fuel Type**

Average Energy Cost (as of June 2018)	
Description	Average Energy Cost
Electricity	\$ 0.73/kWh
#1 Oil	\$ 4.80/gallons

Table D-2 shows the calculated results for the building Energy Use Index (EUI), which determines the total energy usage for a type of building for comparison with other buildings of the same type. This allows the user to determine the relative energy use of a building in relation to others of the same type or use.

**Table D-2: EUI Building Calculations for the Solomon Bed and Breakfast**

Energy Type	Building Fuel Use per Year	Site Energy Use per Year, kBTU	Source/Site Ratio	Source Energy Use per Year, kBTU
Electricity	3,955 kWh	13,498	3.340	45,083
#1 Oil	1,739 gallons	229,496	1.010	231,791
Total		242,994		276,874
BUILDING AREA		3,060	Square Feet	
BUILDING SITE EUI		79	kBTU/ft²/yr.	
BUILDING SOURCE EUI		90	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 D-3 shows information on common energy use benchmarks used to characterize the efficiency of a building.

**Table D-3: Building Benchmarks for the Solomon Bed and Breakfast**

Building Benchmarks			
Description	EUI (kBTU/sq. ft.)	EUI/HDD (BTU/sq. ft./HDD)	ECI (\$/sq. ft.)
Existing Building	79.4	5.77	\$3.67
With Proposed Retrofits	31.0	2.25	\$1.59
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 F– Materials List and Labor Estimation

**Tables E-1 and E-2: ANTHC Materials List and Cost Estimation for the Solomon Bed and Breakfast EEM's**

Energy Retrofit	Required Materials	Quantity <sup>a</sup>	Cost per Item	Total Materials Cost	Total Project Cost <sup>b</sup>
Shell Improvement: Attic Insulation	Blown-in fiberglass insulation (R-38)	75	\$34.57	\$2,592.80	\$4,443
	Machine rental	-	-	\$200.00	
	Recessed lighting cones	57	\$14.97	\$853.30	
Shell Improvement: Wall Insulation	Blown-in insulation (used for cost estimate only)	31	\$34.57	\$1,071.70	\$19,555
	Machine rental	-	-	\$200.00	
	Vapor barrier (used for cost estimate only)	17	\$63.72	\$1,083.20	
	Sheetrock	75	\$30.42	\$2,281.50	
	Additional construction materials (joint tape, screws, putty)	-	-	\$375.00	
Shell Improvement: Windows	Storm window	14	\$800.00	\$11,200.00	\$13,230
Shell Improvement: Doors	Insulated storm doors	9	\$250.00	\$2,250.00	\$2,813
Air sealing	Weather stripping, caulking, spray foam insulation	-	-	\$500.00	\$1,463
	Electrical socket and light switch gaskets (14-pack)	5	\$2.28	\$11.40	
	Door sweeps	9	\$30.19	\$271.70	
Lighting	100 W LED equivalents (daylight; 8-pack)	3	\$40.32	\$121.00	\$560
	60 W LED equivalents (soft white; 4-pack)	14	\$6.97	\$97.60	
	40 W LED equivalents (soft white; 4-pack)	2	\$6.99	\$14.00	
Heating and Domestic Hot Water	Clean and tune furnaces, oil stoves, hot water tank	5	\$250.00	\$1,250.00	\$11,962
	R-8 Duct insulation	9	\$731.00	\$6,579.00	
	Foil tape	4	\$16.58	\$66.30	

	R-6.7 Hot water heater blanket	1	\$28.56	\$28.60	
	Faucet aerators	6	\$3.69	\$22.10	
	Low-flow shower heads	5	\$30.00	\$150.00	
	Teflon tape	2	\$3.50	\$7.00	
Other	Insulated carafe	1	\$35.00	\$35.00	\$40

<sup>a</sup> 10% surplus included.

<sup>b</sup> Project costs include materials, freight (15% of materials cost, and labor).

	Contactor (construction, heating specialist)	Local Labor
Category	Cost (\$)	Cost (\$)
Labor	10,600	2,592
Materials	6,504	25,000
Freight	976	3,750
Travel <sup>c</sup>	-	-
Indirect <sup>d</sup>	5,424	-
Building Inspection Fee	800	-
Historical Preservationist	1,000	-
<b>Subtotal</b>	<b>\$25,304</b>	<b>\$31,341</b>
	<b>Grand Total</b>	<b>\$56,650</b>

<sup>c</sup> Several local contractor companies available in Nome.

<sup>d</sup> Indirect rate is 30% (of the total estimated labor, travel, materials, and freight costs). This represents an estimate of contractor profit, insurance, and bonding costs.

## Appendix G – Example Materials

### 1. Building Shell Improvements [R-38 Blown-in Fiberglass Batt](#)



INNOVATIONS FOR LIVING™

## EcoTouch® Insulation with PureFiber® Technology

### 3-Part Specification

#### SECTION 07 21 16

#### BATT INSULATION

#### PART 1—GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Fiberglass batt insulation of the following types:
  - 1. EcoTouch® Unfaced Insulation
  - 2. EcoTouch® Kraft-faced Insulation
  - 3. EcoTouch® Foil-faced Insulation
  - 4. EcoTouch® FSK-faced Insulation
  - 5. EcoTouch® PSK-faced Insulation

##### 1.2 SUBMITTALS

- A. Product Data: Submit data on product characteristics, performance criteria, and limitations, including installation instructions.
- B. Sustainable Design Submittals: Submit manufacturer's sustainable design certifications as specified.

##### 1.3 QUALITY ASSURANCE

- A. Sustainable Design: Provide products which have received the following certifications:
  - 1. UL Environment EcoLogo CCD-106, applies to EcoTouch® Faced and Unfaced Insulation.
  - 2. GREENGUARD Indoor Air Quality and GREENGUARD Children & Schools, applies to EcoTouch® Unfaced Batts and EcoTouch® Faced Batts and Rolls.
  - 3. GREENGUARD Formaldehyde Free, applies to EcoTouch® Unfaced and EcoTouch® Faced Batts and Rolls.
  - 4. Scientific Certification Systems SCS-MC-01025, SCS Certified minimum 65% recycled glass content (with at least 41% post-consumer recycled and the balance of pre-consumer recycled glass content), applies to EcoTouch® Unfaced Batts and Rolls.
  - 5. Scientific Certification Systems SCS-MC-02676, SCS Certified minimum 58% recycled glass content (with at least 36% post-consumer recycled and the balance of pre-consumer recycled glass content), applies to EcoTouch® Faced Batts and Rolls.

- 6. USDA Certified Biobased Products:
  - EcoTouch® Unfaced – 98 percent; EcoTouch® Kraft-faced – 57 percent; EcoTouch® FSK-faced – 78 percent.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original packaging.
- B. Storage: Store and protect products in accordance with manufacturer's instructions. Store inside and in a dry location. Protect insulation materials from moisture and soiling.
- C. Inspection: Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

#### PART 2—PRODUCTS

##### 2.1 MANUFACTURER

- A. Thermal Insulation: EcoTouch® PINK® FIBERGLAS® Insulation with PureFiber® Technology by Owens-Corning.

##### 2.2 MATERIALS

- A. EcoTouch® Unfaced Batt Insulation: ASTM C665, Type I, preformed formaldehyde free glass fiber batt type, unfaced. Includes Unfaced SonoBatts and Sound Attenuation Batts.
  - 1. Noncombustible per ASTM E136.
  - 2. Flamespread less than 25, smoke developed less than 50 per ASTM E84.
  - 3. ICC Building Code Construction Classification: All types.
  - 4. Water vapor sorption, Maximum by weight: not more than 5 percent.
- B. EcoTouch® Kraft Faced Batt Insulation: ASTM C 665, Type II, Class C preformed formaldehyde free glass fiber batt type, Kraft paper faced one side. Includes Kraft faced SonoBatts and EcoTouch® ProPink FastBatt Insulation.
  - 1. ICC Building Code Construction Classification: III, IV, V.
  - 2. Perm Rating: 1 perm maximum per ASTM E96.
- C. EcoTouch® Foil Faced Batt Insulation: ASTM C 665, Type III, Class C preformed formaldehyde free glass fiber batt type, foil faced one side.
  - 1. Flamespread less than 75, smoke developed less than 150 per ASTM E84.

### 3-Part Specification

2. ICC Building Code Construction Classification: III, IV, V.
3. Perm Rating: 0.5 perm maximum per ASTM E96.
- D. EcoTouch® FS-25 Batt Insulation: ASTM C665, Type II (PSK facing), Class A and Type III (FSK facing), Class A preformed formaldehyde free glass fiber batt, poly/scrim/Kraft (PSK) or foil/scrim/Kraft (FSK) faced on one side.
  1. Flame spread less than 25, smoke developed index less than 50 per ASTM E84
  2. ICC building construction classification: all types.
  3. Perm Rating: 0.02 maximum per ASTM E96
- E. Accessories: Provide accessories per insulating system manufacturer's recommendations, including the following:
  1. Tape: Polyethylene self-adhering type for Kraft faced insulation and bright aluminum self-adhering type for foil faced insulation.
  2. Insulation Fasteners: Impale clip of galvanized steel; type recommended by insulation manufacturer for particular use intended.
  3. Mechanical Insulation Fasteners: FM approved, corrosion resistant, size required to suit application.
  4. Wire Mesh: Galvanized steel, hexagonal wire mesh.
  5. Spindle Fasteners: Corrosion-resistant wire spindles.
  6. Ventilation Baffles: Formed plastic, metal, or cardboard sized to fit full width of rafter spaces.
4. R-19, 6-¼ inch (159mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 48 inch (1219mm) or 93 inch (2362mm) length.
5. R-21, 5-½ inch (139mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 93 inch (2362mm) length.
- B. Wood Frame Construction—Roof/Floor/Ceiling, R-Value: Per ASTM C518.
  1. R-19, 6-¼ inch (159mm) thickness, 15 inch (381mm) or 19-¼ inch (489mm) or 23 inch (584mm) width, 48 inch (1219mm) or 93 inch (2362mm) length.
  2. R-22, 6-¾ inch (171mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 48 inch (1219mm) length.
  3. R-25, 8 inch (203mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 48 inch (1219mm) length.
  4. R-30C, 8-¼ inch (209mm) thickness, 15-½ inch (394mm) or 23-¾ inch (584mm) width, 48 inch (1219mm) length.
  5. R-30, 9-½ inch (241mm) thickness, 16 inch (406mm) or 19-¼ inch (489mm) or 24 inch (584mm) width, 48 inch (1219mm) length.
  6. R-38C, 10-¼ inch (260mm) thickness, 15-½ inch (394mm) or 23-¾ inch (584mm) width, 48 inch (1219mm) length.
  7. R-38, 12-¼ inch (305mm) thickness, 16 inch (406mm) or 24 inch (584mm) width, 48 inch (1219mm) length.
- C. Metal Frame Construction, R-Value for Batt Insulation: Per ASTM C518.
  1. R-8, 2 ½ inch (64mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 96 inch (2438mm) length.
  2. R-11, 3-½ inch (89mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 48 inch (1219mm) or 96 inch (2438mm) length.
  3. R-13, 3-½ inch (89mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 48 inch (1219mm) or 96 inch (2438mm) length.
  4. R-15, 3-½ inch (89mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 96 inch (2438mm) length.
  5. R-19, 6-¼ inch (159mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 48 inch (1219mm) or 96 inch (2438mm) length.

### 2.3 PERFORMANCE CRITERIA

- A. Wood Frame Construction—Walls, R-Value: Per ASTM C518.
  1. R-11, 3-½ inch (89mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 48 inch (1219mm) or 93 inch (2362mm) length.
  2. R-13, 3-½ inch (89mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 48 inch (1219mm) or 93 inch (2362mm) length.
  3. R-15, 3-½ inch (89mm) thickness, 15 inch (381mm) or 23 inch (584mm) width, 93 inch (2362mm) length.



## 3-Part Specification

6. R-21, 5-1/2 inch (139mm) thickness, 16 inch (406mm) or 24 inch (609mm) width, 96 inch (2438mm) length.

### PART 3—EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, penetrations, adjoining construction and the conditions under which work is to be installed. Verify that surfaces are dry and free of contaminants.
- B. Report unacceptable conditions in writing. Do not proceed with the work until unsatisfactory conditions have been corrected and surfaces are acceptable.

#### 3.2 INSTALLATION OF INSULATION

- A. General: Install insulation according to manufacturer's instructions, including compliance with instructions for safety and the following:
  1. Completely fill cavity top-to-bottom, side-to-side and back-to-front, with no voids, gaps or areas of compression that could reduce thermal value.
  2. Do not install insulation on top of or within 3 inches of recessed light fixtures unless the fixtures are approved for such use.
  3. Install insulation at band joists and rim joists.
  4. In crawl spaces and where the underside of floors are exposed to unconditioned space, insulation shall fill the cavity or be installed in contact with the underside of the decking. If vapor retarder is required by local code, a Kraft vapor retarder must be in contact with a 15 minute thermal barrier. Placement of vapor retarder shall comply with requirements of local jurisdiction.
  5. Within exterior wall framing, install insulation between pipes and backside of sheathing. Cut or split insulation material as required to fit around wiring and plumbing.
  6. Where showers and bath tubs are located on exterior walls, install insulation and vapor retarder air barrier between units and exterior.
- B. Batt Insulation: Install batt insulation in accordance with ASTM C 1320 and the following:
  1. If eave ventilation baffles are required, install ventilation baffles at eaves to hold insulation down from roof sheathing and provide positive ventilation from eave to attic space.

2. Fluff insulation to full thickness for specified R-value before installation. Do not compress insulation in the cavity during installation, creating gaps or voids that could diminish thermal value.
3. Trim insulation neatly to fit spaces. Fill miscellaneous gaps and voids with insulation.
4. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
5. For unfaced batt insulation, install with friction fit or retain in place with manufacturer's recommended fasteners or mesh.
6. For batt insulation with factory-applied facing, install with vapor retarder membrane facing the warm in winter side of building spaces or as specified by local building code. Lap ends and side flanges of membrane over or between framing members. Tape to seal, tears, cuts or misalignments in membrane.
7. Secure insulation in place using one of the following methods: Friction fit; staple or nail facing flanges in place as needed, tape in place, retain in place with spindle fasteners, retain in place with wire mesh secured to framing members.

#### 3.3 PROTECTION OF INSULATION

- A. Protect insulation from damage due to weather and physical abuse until protected by permanent construction.

End of Section

2. **Lighting Recommendations**  
[100 Watt LED Equivalent Bulbs](#)

## Specifications

### Dimensions

Bulb Diameter (in.)	2.36
Product Depth (in.)	4.92

### Details

Actual Color Temperature (K)	5000
Average Life (hours)	10950
Bulb Construction	Plastic
Bulb Shape	Standard
Bulb Type	Household
Color Rendering Index (CRI)	80
Color Temperature	Daylight
Indoor/Outdoor	Indoor
Light Bulb Base Code	E26
Light Bulb Base Type	Medium

### Warranty / Certifications

Manufacturer Warranty	3 Year Warranty
Product Height (in.)	4.37
Product Width (in.)	2.48

Light Bulb Features	Energy Saving
Light Bulb Shape Code	A19
Lighting Technology	LED
Lumens (Brightness)	1500
Number of Bulbs Included	8
Returnable	90-Day
Specialty Bulb Type	Household / General Purpose
Wattage (Watts)	14
Wattage Equivalence	100



## Specifications

### Dimensions

Bulb Diameter (in.)	2.375
Product Depth (in.)	2.40

### Details

Actual Color Temperature (K)	2700
Average Life (hours)	10000
Bulb Construction	Plastic
Bulb Shape	Standard
Bulb Type	Household
Color Rendering Index (CRI)	80
Color Temperature	Soft White
Indoor/Outdoor	Indoor
Light Bulb Base Code	E26
Light Bulb Base Type	Medium

### Warranty / Certifications

Manufacturer Warranty	This item has 3 year warranty. Please see the back of the package for details.
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Product Height (in.)	6.89
Product Width (in.)	2.40

Light Bulb Features	Energy Saving
Light Bulb Shape Code	A19
Lighting Technology	LED
Lumens (Brightness)	800
Number of Bulbs Included	4
Returnable	90-Day
Specialty Bulb Type	Household / General Purpose
Wattage (Watts)	8.5
Wattage Equivalence	60

## [40 Watt LED Equivalent Bulbs](#)

### Dimensions

Bulb Diameter (In.)	2.63
Product Depth (in.)	2.63 in

### Details

Actual Color Temperature (K)	2700
Average Life (hours)	15000
Bulb Construction	Plastic
Bulb Shape	Standard
Bulb Type	Household
Color Rendering Index (CRI)	80
Color Temperature	Soft White
Indoor/Outdoor	Indoor
Light Bulb Base Code	E26
Light Bulb Base Type	Medium

### Warranty / Certifications

Manufacturer Warranty	5 YEARS
Product Height (in.)	5.28 in
Product Width (in.)	2.63 in

Light Bulb Features	Dimmable,Energy Saving
Light Bulb Shape Code	A19
Lighting Technology	LED
Lumens (Brightness)	480
Number of Bulbs Included	4
Returnable	90-Day
Specialty Bulb Type	Household / General Purpose
Wattage (Watts)	5.6
Wattage Equivalence	40

### 3. Heating and Domestic Hot Water Recommendations

#### [R-6.7 Hot Water Heater Jacket](#)

## Specifications

### Dimensions

Coverage Area (sq. ft.)	25	Product Length (ft.)	6.25 ft
Product Depth (in.)	2	Product Thickness (in.)	2 in
Product Height (in.)	75	Product Width (in.)	48

### Details

Formaldehyde Free	Yes	Product Weight (lb.)	6lb
Insulation Application Type	Garage	Returnable	90-Day
Insulation R-Value	6.7	Roll or Batt	Roll
Insulation Type	Recycled Denim	Vapor Retardant	No
Product Type	Blanket/Jacket		

### Warranty / Certifications

Warranty Information	1 Yr Limited Warranty		
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#### [Faucet Aerators](#)

## Specifications

### Dimensions

Product Depth (in.)	0.909	Product Width (in.)	0.909
Product Height (in.)	0.669		

### Details

Application	Bathroom Sink,Kitchen Sink	Material	Brass
Color/Finish	Chrome	Plumbing Part Type	Aerator
Color/Finish Family	Chrome	Tamper Resistant	No
Fits Faucet Brand	All Brands	Thread Pitch (Threads Per Inch)	27
Flow Rate	1.5 gal (US)/min	Thread Size (In.)	15/16x55/64
Flow Restrictor	Yes	Thread Type	Dual-Threaded

### Warranty / Certifications

Manufacturer Warranty	Limited 1-year warranty		
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## [Low-Flow Shower Heads](#)

### Specifications

#### Dimensions

Connection Size	1/2 in.	Product Width (in.)	4.38
Product Depth (in.)	3.38	Showerhead face diameter (in.)	4.38
Product Height (in.)	3.38		

#### Details

Color Family	Chrome	Product Weight (lb.)	.8lb
Color/Finish	Polished Chrome	Returnable	90-Day
Features	Adjustable Stream,Low Flow,Self-cleaning Nozzles	Shower Head Shape	Round
Flow rate (gallons per minute)	2.0	Shower Head Size	Medium Shower Head
Included Components	No Additional Items	Shower Head Type	Single
Mounting Type	Wall Mount	Spray Pattern	Adjustable
Number of Spray Settings	3	Style	Modern
Product Type	Fixed Showerhead		

#### Warranty / Certifications

Certifications and Listings	No Certifications or Listings	Manufacturer Warranty	Limited Lifetime Warranty
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## ***Appendix H – Additional Photos of the Solomon Bed and Breakfast***



**The Solomon Bed and Breakfast exterior.**

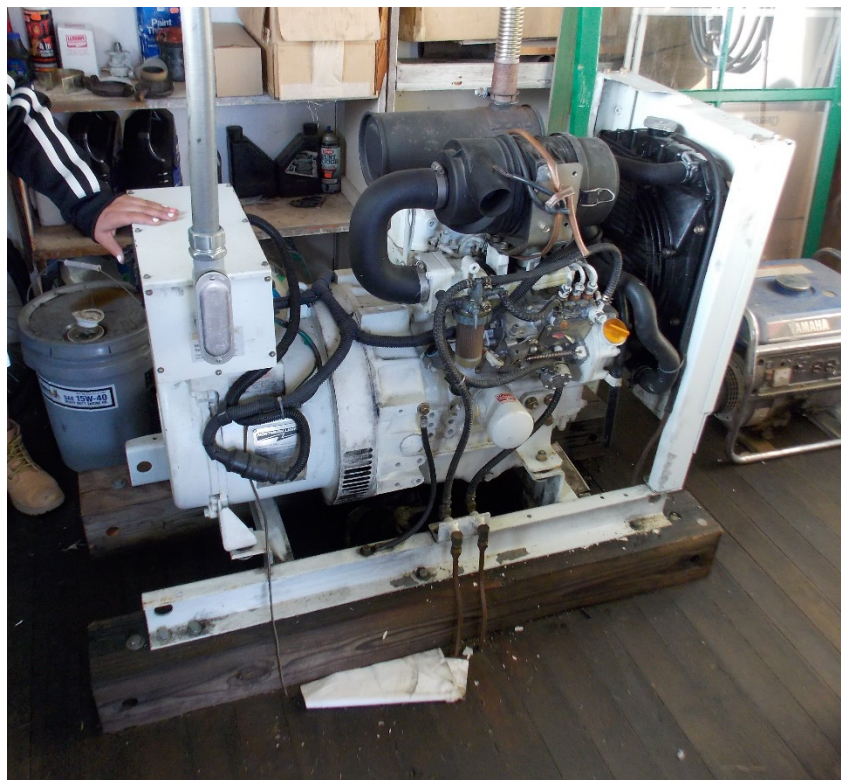


**Inside the crawlspace under the building floor. Snow builds up under the building over the course of the winter, creating potential freeze problems for any exposed, uninsulated plumbing once the building is reopened in the summer. The gaps between the ground and the crawlspace walls should be sealed to prevent snow intrusion. The Solomon Bed and Breakfast may consider insulating all exterior plumbing for another layer of protection**





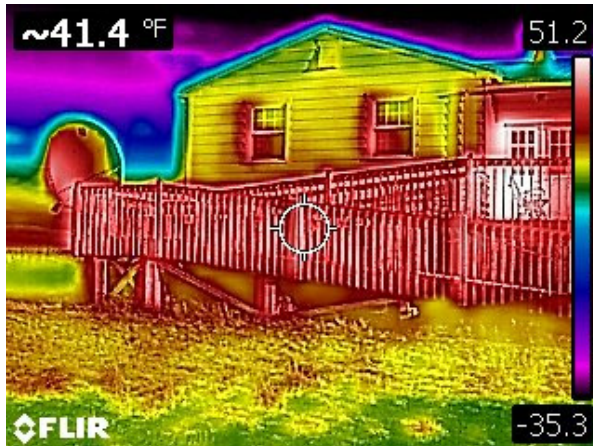
The subfloor appeared to be well sealed and in good condition at the time of the site visit. All plumbing penetrations could use additional spray foam insulation on both the exterior and interior of the building.



Northern Lights 10 kW diesel generator. All of the electricity consumed by the Solomon Bed and Breakfast is generated on site.



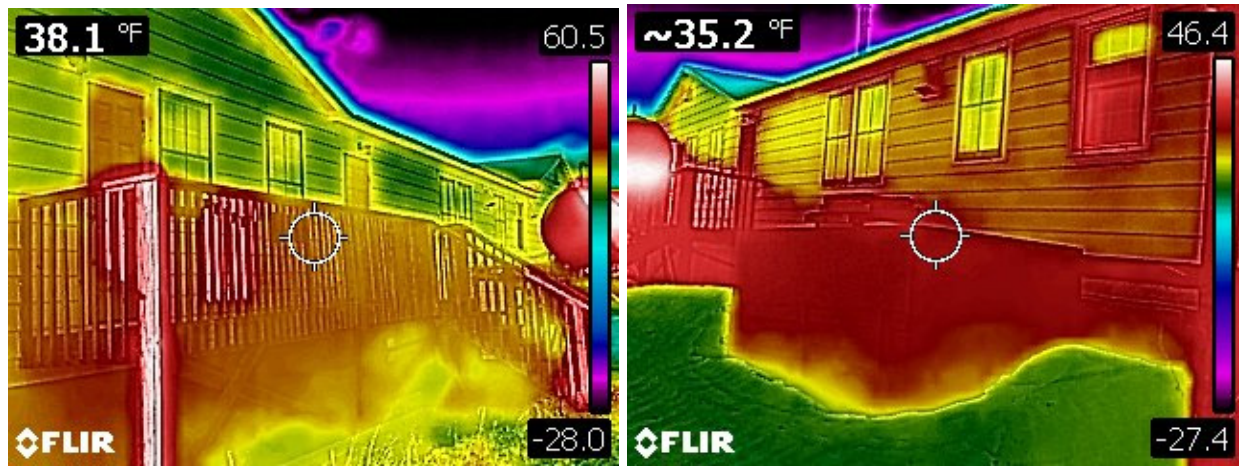
Wall and ceiling penetrations, such as attic hatches and two baffled vents in the kitchen, are not well insulated. Adding rigid foam insulation would help prevent heat loss at these points.



FLIR thermal imaging of the building front. The color gradient on the right in each image depicts the temperature range of the photo (in degrees Fahrenheit). Colors in the higher end of the gradient indicate where heat is being lost. Note the white area at the double door off of the Classroom. There was a gap between the door and doorframes at that location. Installing weather-stripping, new door sweeps, and insulated storm doors will reduce heat loss at this area.

The two windows in the image on the left are double paned, but do not have a storm window. The three windows in the image on the right are double paned and have single pane storm windows installed on the exterior. There is visibly less heat loss through the windows in the right-side image.





FLIR thermal imaging of the building rear. The color gradient on the right in each image depicts the temperature range of the photo (in degrees Fahrenheit). Colors in the higher end of the gradient indicate where heat is being lost. Note: sunlight was heating the porch post in the left-hand image. There is no heat loss through that point.