Feasibility Assessment for Biomass Heating Systems at Pearl Creek, Weller, Two Rivers and Salcha Elementary Schools

FINAL REPORT – 7/28/2017

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Abbreviations

ACF	Accumulated Cash Flow
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
AEA	Alaska Energy Authority
AFUE	Annual Fuel Utilization Efficiency
B/C	Benefit / Cost Ratio
BTU	British Thermal Unit
BTUH	BTU per hour
CFM	Cubic Feet per Minute
Eff	Efficiency
F	Fahrenheit
ft	Feet
FNSB	Fairbanks North Star Borough
FNSBSD	Fairbanks North Star Borough School District
GPM	Gallons Per Minute
HP	Horsepower
HVAC	Heating, Ventilating, and Air-Conditioning
in	Inch(es)
kW	Kilowatt(s)
kWh	Kilowatt-Hour
lb(s)	Pound(s)
MBH	Thousand BTUs per Hour
O&M	Operations and Maintenance
MMBTU	One Million BTUs
PC	Project Cost
R	R-Value
SF	Square Feet, Supply Fan
TEMP	Temperature
TPY	Tons per Year
V	Volts
W	Watts

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1. Executive Summary

Coffman performed a preliminary biomass feasibility assessment for the Fairbanks North Star Borough to determine the technical and economic viability of biomass heating systems at four elementary schools in the Fairbanks area of Alaska: Pearl Creek, Weller, Two Rivers and Salcha. The proposed biomass heating systems are wood pellet boilers located in detached modules with heating pipes to the schools. A local wood pellet supplier would deliver pellets to an adjacent wood pellet silo.

Due to the current low price of heating oil at $2.90/gal, the benefit to cost ratios for each school is less than 1.0 and therefore the wood pellet systems at the schools are not economically justified at this time.

However, the price of heating oil can vary greatly over time and as heating oil prices rise these projects can become economically viable. For example, when heating oil reaches $3.50/gal the wood pellet boiler projects at Pearl Creek and Weller become economically justified.

The pellet boiler projects at Pearl Creek and Weller are more economic than at Two Rivers and Salcha. The reason for this is the greater amount of heating oil that can be offset in the larger schools of Pearl Creek and Weller, compared to the cost of the new pellet boiler system. Two Rivers and Salcha are less economic due to the relatively small heating oil offset and high project costs.

A summary of each projects economic analysis is shown in the following table.

Table 1 – Executive Summary

Item	Pearl Creek	Weller	Two Rivers	Salcha
Project Capital Cost	($673,000)	($505,000)	($489,000)	($475,000)
Present Value of Project Benefits (20-year life)	$1,027,021	$788,970	$462,500	$333,272
Present Value of Operating Costs (20-year life)	($523,154)	($403,473)	($240,550)	($170,467)
Benefit / Cost Ratio of Project (20-year life)	0.75	0.76	0.45	0.34
Net Present Value (20-year life)	($169,133)	($119,503)	($267,050)	($312,195)
Year Cash Flow is Net Positive	First Year	First Year	First Year	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years	>20 years	>20 years	>20 years

The current energy prices in Fairbanks are shown in the following table. Wood pellets are less expensive than heating oil and electricity on an energy basis.

Table 2 – Energy Comparison

Community	Fuel Type	Units	Gross BTU/unit	System Efficiency	$/unit	Delivered $/MMBTU
Fairbanks	Wood Pellets	ton	16,600,000	80%	$275	$20.71
	Heating Oil	gal	134,000	65%	$2.90	$33.30
	Electricity	kWh	3,413	99%	$0.20	$59.19

2. Introduction

A preliminary feasibility assessment was completed to determine the technical and economic viability of biomass heating systems for four elementary schools in the Fairbanks area of Alaska: Pearl Creek, Weller, Two Rivers and Salcha. The Fairbanks North Star Borough School District (FNSBSD) operates and maintains the elementary schools, while the Fairbanks North Star Borough (FNSB) provides capital for constructing the schools. The FNSB received a grant from the Fairbanks Economic Development Corporation (FEDC) for the feasibility study of the schools.

Figure 1 – Pearl Creek Elementary

Figure 2 – Weller Elementary

Figure 3 – Two Rivers Elementary

Figure 4 – Salcha Elementary

3. Preliminary Site Investigation

Building Descriptions

Each elementary school is occupied during the typical school day and was built with typical construction methods for their vintage in the Fairbanks area. Energy audits were completed for all schools in 2012. For each school, the square footage, date of construction, occupant characteristics and type of construction is shown in the following table.

Table 3 – Building Properties

School	Square Footage	Year Built	Occupants	Type of Construction
Pearl Creek	62,982	1983	500 students, 60 staff	CMU block and metal stud walls (R-19 to R-30) and built-up flat roof with rigid insulation (R-60)
Weller	65,259	1983	540 students, 40 staff	CMU block and 2x8 stud walls (R-26) and built-up roof with metal trusses (R-35)
Two Rivers	22,200	1982	90 students, 20 staff	CMU block and 2x8 stud walls (R-25) and hot roof with metal trusses (R-50)
Salcha	13,608	1963	88 students, 9 staff	2x6 and 2x12 stud walls (R-19 to R-28) and hot roof (R-60). A major upgrade was made in 2015 that improved building envelope.

Existing Heating System

All schools are heated with cast-iron sectional oil-fired boilers that serve air handlers, cabinet unit heaters, and perimeter base board using glycol. Domestic hot water (DHW) is provided by standalone oil-fired hot water heaters. All of the schools are controlled by direct digital control (DDC) systems that can be viewed and controlled remotely by the FNSBSD. All of the boilers are 1980's vintage and appear to be working in adequate condition. There were no specific maintenance issues reported during the site visit. The following table shows the heating capacities of the boiler plants.

Table 4 – Building Properties

School	Boiler Plant	DHW Plant	Fuel Tank
Pearl Creek	Two Weil McLain Boilers, Model BL-1386 S-W, 2,700 MBH Gross Output Each	Bock Hot Water Heater, Direct-Fired, 85 gal	5,000-gal underground fuel tank
Weller	Two Burnham Boilers, Model BF-507, 1,116 MBH Gross Output Each	Bock Hot Water Heater, Direct-Fired, 212 gal	5,000-gal underground fuel tank
Two Rivers	Two Burnham Boilers, Model PF-505, 786 MBH Gross Output Each	Bock Hot Water Heater, Direct-Fired, 135 gal	5,000-gal underground fuel tank
Salcha	Two Burnham Boilers, Model V-38, 438 MBH Gross Output Each	Bock Hot Water Heater, Direct-Fired, 50 gal	3,000-gal underground fuel tank

The boilers, central pumps and hot water heaters are located in mechanical rooms. The combustion efficiency of the boilers is unknown, as no combustion test reports were available. For this study, the Annual Fuel Utilization Efficiency of the boiler system is estimated at 65% to account for typical oil boiler inefficiencies, including short cycling, due to the age of the boilers.

Weller Elementary is unique in that it has a solar thermal system that provides supplemental heating to the building's DHW system.

Available Space, Street Access, Fuel Storage and Site Constraints

Each school has site constraints associated with available space, access, and fuel storage. Most of the prime area around the schools are already in use as playgrounds, fields, parking lots, or view sheds from classrooms.

Pearl Creek

Pearl Creek is the largest elementary school studied. The oil boilers are located in a basement room that has limited access and no space for future biomass boilers or equipment. There are no other suitable locations inside the school for biomass equipment. A detached biomass boiler module or addition is required.

The school is built into a west facing hill, which limits access to the north of the building. There are also buried fuel tanks and fire water tanks at the north of the building. The west of the building is the playground and the entry way and garden are at the south of the building. Due to these constraints, the proposed location of a new biomass boiler module is on a new gravel pad to the east of the building. A new pellet silo would be on the gravel pad as well. A new gravel access driveway from the street would be required. This location was used for the basis of estimate.

A secondary option is to locate the biomass boiler module to the north of the building, however, significant excavation will be required due to the steep hill there.

A site layout of the major site constraints at Pearl Creek is shown on the following page.

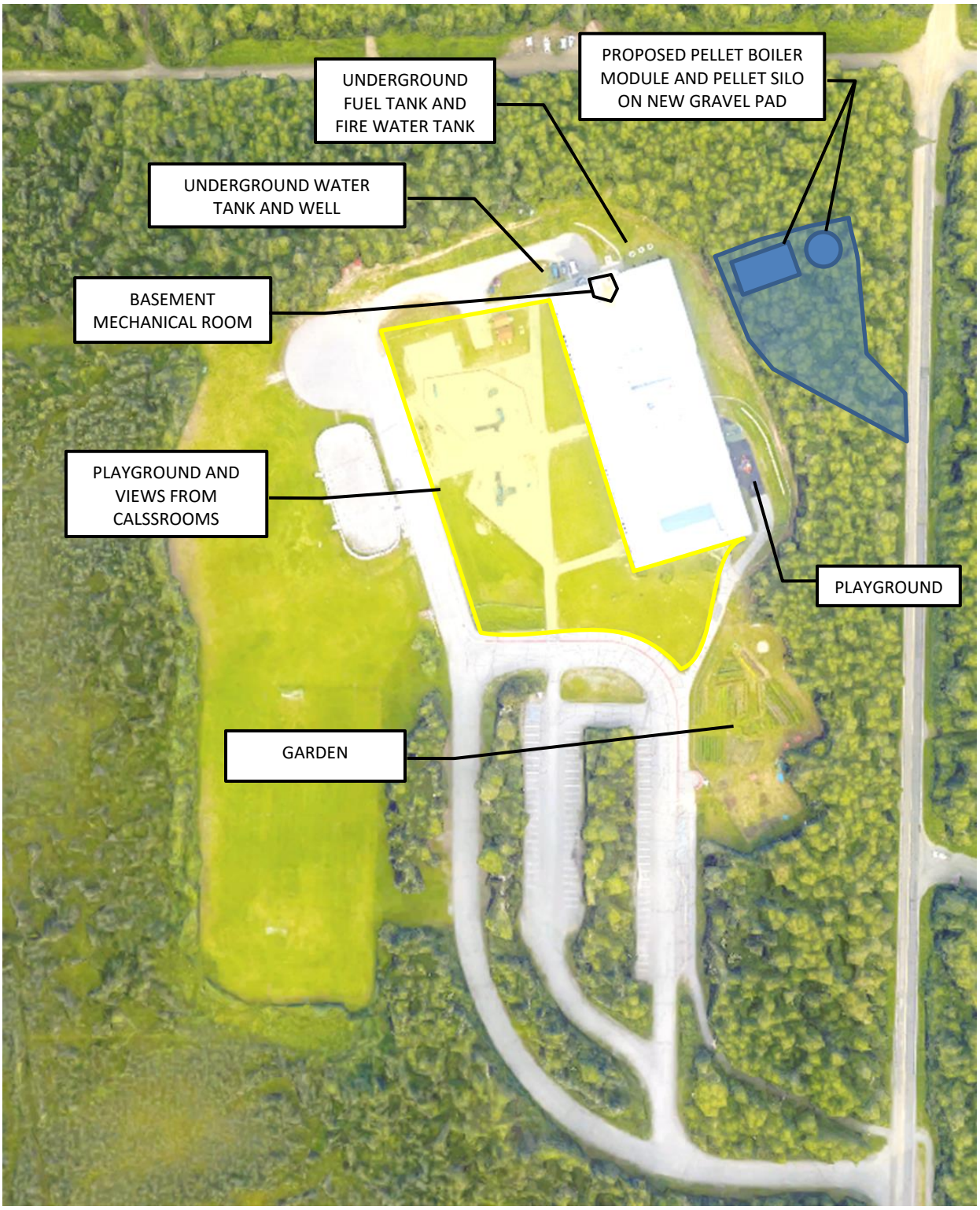


Figure 5 – Pearl Creek Site Layout

Weller

The oil boilers at Weller Elementary are located on the second-floor mechanical room. There is no space inside this mechanical room for a biomass boiler or equipment. There is an adjacent mechanical room that contains water treatment equipment and is used as storage that has space that could be used for a biomass boiler system. However, this room is far from exterior walls, making it very difficult to transfer wood pellets from an exterior silo to the biomass boiler. Due to these constraints, a detached biomass boiler module is proposed.

All the space surrounding the school is currently being used. The north and east sides of the school are parking lots. The south side of the school is a grass field that is also the south view shed for two stories of classrooms. The west side of the school is the playground. Any location of a new biomass boiler module will impact any of these above locations. From a purely practical perspective, the most ideal location of the biomass module would be on the west side of the school, as this would be the shortest piping run to the school's boiler room and easily accessible for pellet delivery. However, this location of the module would take away a section of the playground.

The north and east parking lots are surrounded by steep hills that make building in these areas difficult. The parking lot could also be used as a potential location, however trenching through the concrete parking lot will add significant cost.

For this feasibility study, no specific location was selected because the final location will depend of the priorities of the school. For cost estimating purposes, it is assumed the new biomass boiler module will be on the west side of the school.

A site plan of the major site constraints at Weller is shown on the following page.

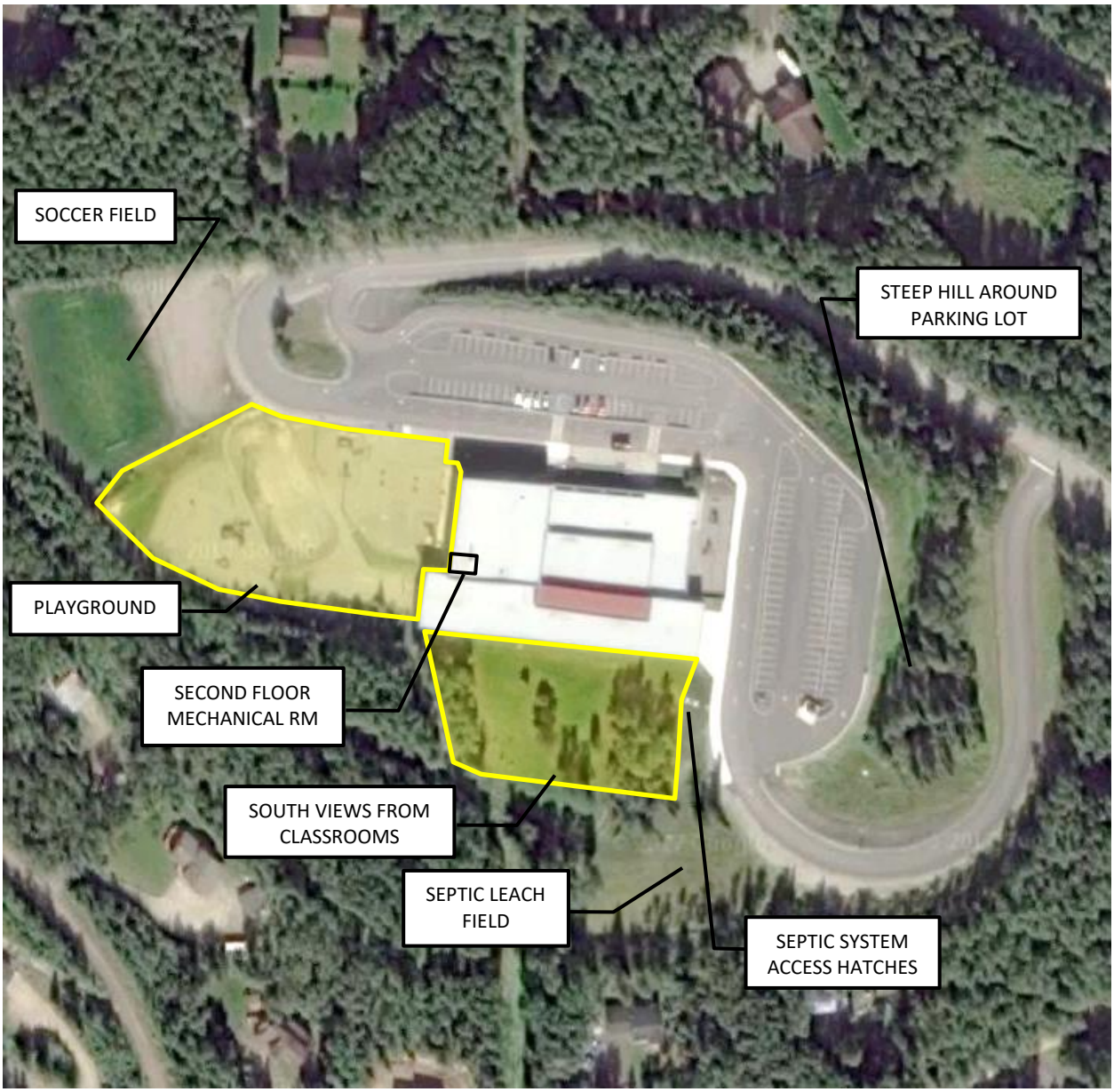


Figure 6 – Weller Site Layout

Two Rivers

The oil boilers at Two Rivers Elementary are located on the first floor mechanical room. The mechanical room has below grade walls because the school is built into a south facing hillside. The existing boiler room is completely full of existing equipment and there is no available space for a new biomass boiler system. A new biomass boiler module is required.

There is limited space around the school for a new biomass boiler module. The north side of the school is a parking lot and has existing buried utilities and a maintenance access area. The west side of the school is the main entry. The south side of the school is the playground, fields and southern views for the classrooms. The only space that appears practical for a new module is to the east of the school, adjacent to the driveway. A new gravel pad would be required for the module and the pellet silo. This area is currently not in use and is relatively close to the existing mechanical room. There is a buried fuel tank near the school that would have to be avoided during trenching of the heat piping from the module to the school. A site plan of the major site constraints is shown below.

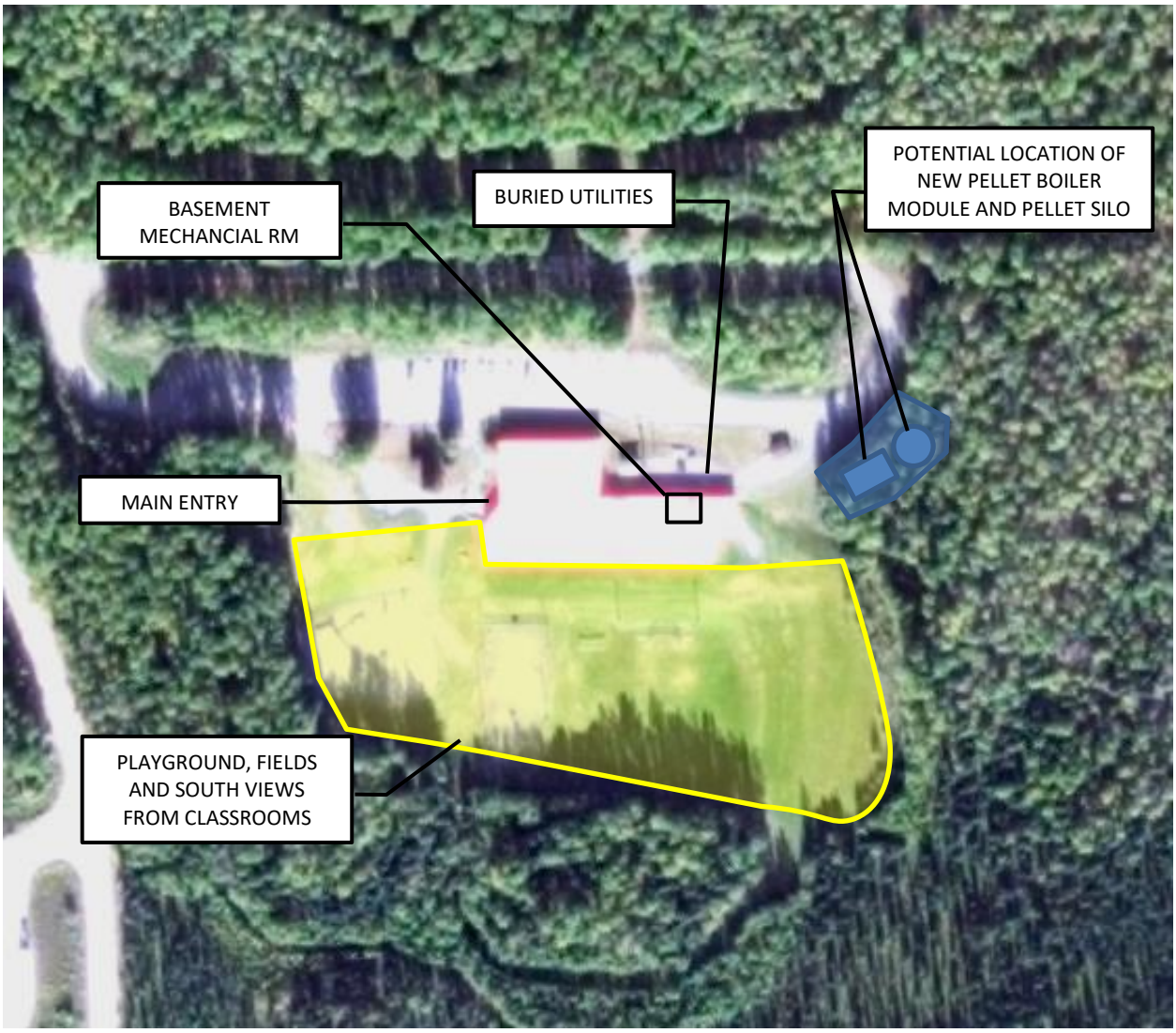


Figure 7 – Two Rivers Site Layout

Salcha

The oil boilers at Salcha Elementary are located in a first floor mechanical room, on the east side of the building. There is no available space in the existing mechanical room for a new biomass boiler system. A new biomass boiler module is required.

There is limited space and access around the school for a biomass boiler module. The parking lot is small and offers limited access to only the west side of the school. The south side of the school has the septic leach field. The school is surrounded by Nordic ski trails on the south, east, and north of the school. The playground and parking lot on situated on the west side of the school. Due to these site constraints, the only practical space for a new module and pellet silo is on the south side of the parking lot. This will reduce the parking area at the school. Siting of the module and silo will be constrained by the septic leach field, fire water pump house and power pole that exist in the area. A buried heat pipe can be trenched from the module around the south side of the school to the exterior wall of the school's mechanical room. A buried fire water line, sewer line and fuel line exist in this area, so caution will be required during trenching.

A site plan of the major site constraints at Salcha Elementary is shown on the following page.

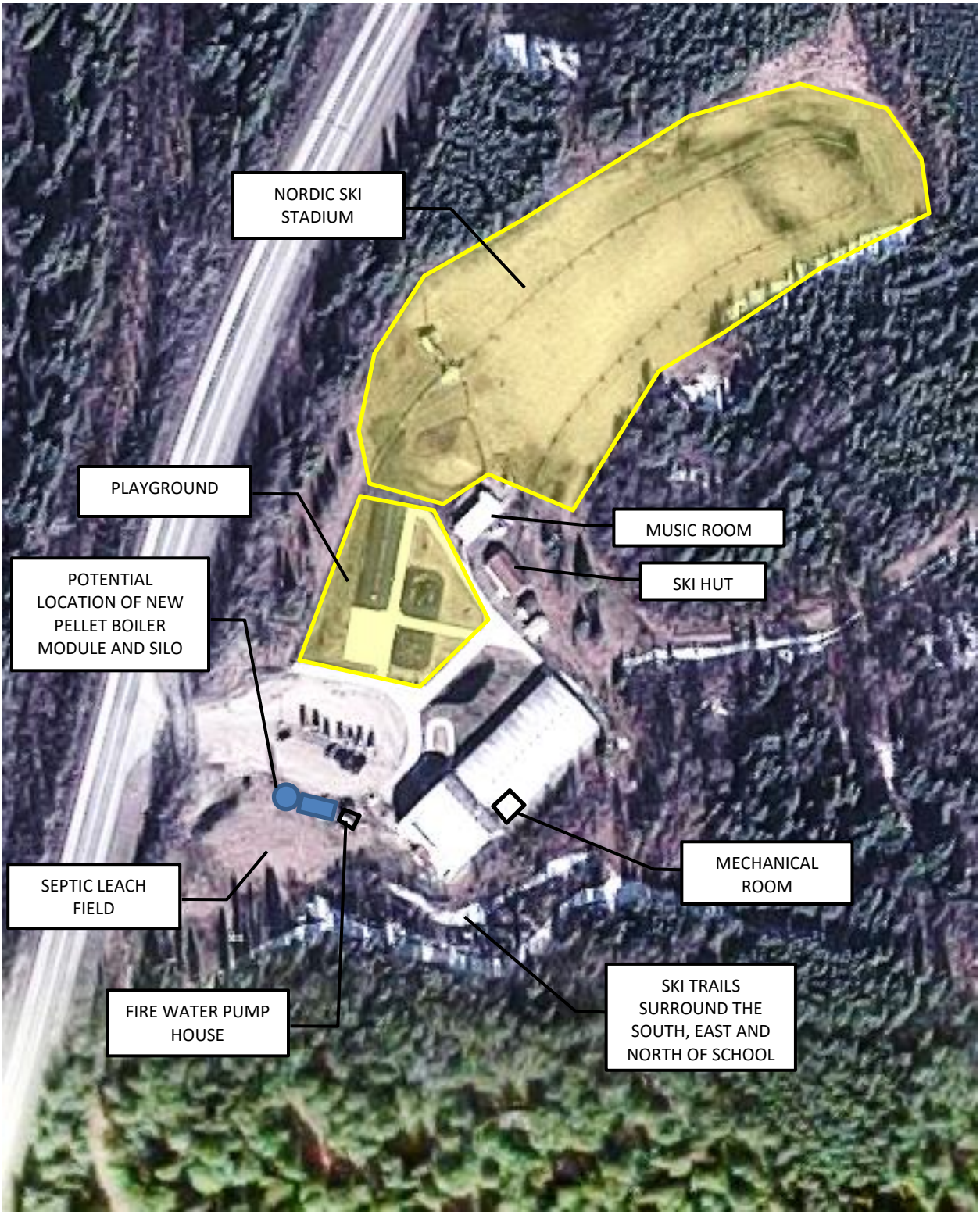


Figure 8 – Salcha Site Layout

4. Biomass System

Biomass System Options

The biomass boiler system selected as the basis of design for the four elementary schools is a wood pellet boiler. Wood pellets are the best fit for the schools because they are fully automated boilers that require limited labor for operation and fuel handling. Cord wood boiler systems were not considered because they require manual loading and firing of cord wood, which requires significant labor. Wood chip systems were considered, but were not selected because of the availability of local wood pellets. The handling of pellets is much easier than wood chips or cord wood.

For this study, a Viessmann RF-300 wood pellet boiler was selected. The boiler has been successfully installed and operated in Alaska (at the Ketchikan Airport) and is a high-quality pellet boiler. The high efficiency boiler can modulate down to 4:1 and has ultra-low emissions. It has automatic ignition and low maintenance. Different boiler sizes were selected for each school. The 540kW (1,843 MBH) unit was selected for Pearl Creek, the 220kW (750 MBH) selected for Weller, and the 150kW (512 MBH) unit selected for Two Rivers and Salcha.

Figure 9 – Viessmann RF-300 Wood Pellet Boiler

The biomass boiler would be installed in an 11.5ft wide x 10ft high x 29ft long insulated module. The module would be fabricated offsite and would include a thermal storage tank, pellet augers, cyclone separator, pumps, piping and wiring for a fully complete system. The module would be shipped to Fairbanks to be installed onsite. The module would be installed on a concrete pad with a pellet silo

adjacent to it. Polydome pellet silos that can store 8.5 tons of pellets each, were selected as the basis of design because the local pellet supplier has had a good track record with these units.

The combustion efficiency of the pellet boiler can reach 85%. Using thermal storage will also help the unit run at higher efficiencies during normal operation. For this study, an Annual Fuel Utilization Efficiency of 80% was used, to account for normal operations throughout the year.

Biomass System Integration

Integration for all four of the elementary schools will be very similar. The detached biomass boiler module will house the pellet boiler and thermal storage tank. The pellet boiler and thermal storage tank are ASME rated and will operate with glycol. A buried, insulated piping loop will transfer heat using glycol from the boiler module to the school's mechanical room. In the mechanical room, a new heat exchanger will transfer heat from the pellet boiler loop to the school's heating glycol return loop. The heat exchanger is used to separate the school's glycol from the pellet boiler's glycol, to protect the school's system from a potential leak in the pellet boiler's heat loop. Glycol is used for freeze protection. A new pump will be required to pump glycol from the pellet boiler module to the school heat exchanger. The new pellet boiler module will require an electrical connection to power the pellet boiler and associated equipment.

The existing hydronic systems in the schools are set to operate at 180°F heating glycol supply / 160°F return, which the pellet boiler can reach. Controls for the new biomass systems can be integrated into the existing DDC controls at each facility.

5. Energy Consumption and Costs

Energy Costs

The table below shows the energy comparison of different fuel types in the community. The system efficiency is used to calculate the delivered MMBTU's of energy to the building. The delivered cost of energy to the building, in $/MMBTU, is the most accurate way to compare costs of different energy types. As shown below, wood pellets are cheaper than fuel oil on a $/MMBTU basis in the Fairbanks area.

Table 5 – Energy Comparison

Community	Fuel Type	Units	Gross BTU/unit	System Efficiency	$/unit	Delivered $/MMBTU
Fairbanks	Wood Pellets	ton	16,600,000	80%	$275	$20.71
	Heating Oil	gal	134,000	65%	$2.90	$33.30
	Electricity	kWh	3,413	99%	$0.20	$59.19

Cord Wood

Cord wood was evaluated as a biomass fuel, but was not considered viable due to the additional handling requirements. In order to burn cord wood, a person is required to stack, move and fire cord wood daily, if not multiple times per day. Cord wood was not considered viable because the FNSB wishes to have a more automated biomass system that does not require additional labor.

Wood Pellets

The local wood pellet manufacturer is Superior Pellets, located in North Pole, AK, and sells bulk wood pellets at $275/ton including delivery. According to Superior Pellets, the cost of bulk pellets has stayed constant over the years and they do not anticipate large swings in pricing, such as is found with fuel oil. Superior Pellets are at 5% moisture content and have an energy content of 8,300 BTU/lb (16,600,000 BTU/ton). A bulk pellet truck can deliver up to 15 tons of wood pellets to the school on a scheduled or as needed delivery. Typically, an initial schedule is set up to determine the actual consumption of wood pellets and then the schedule is modified after that. Superior Pellets has been using Polydome silos for pellet storage in the Fairbanks area and has had good success with the units. For the basis of design, one 8.5-ton pellet silo is used for each school. The frequency of delivery will be different for each school depending on consumption.

Heating Oil

The high price of fuel oil is the main economic driver for the use of lower cost biomass heating. Fuel oil is currently purchased at $2.90/gal. The price of fuel oil has fluctuated greatly over time, and currently appears to be at a lower price than in the recent past. The wide variation of fuel oil prices is a disadvantage compared to more stably priced wood pellets. For this study, the energy content of fuel oil is based on 134,000 BTU/gal, according to "Heating Values of Fuels" by the UAF Cooperative Extension, 2009.

Electricity

Electricity for the schools is provided by the Golden Valley Electric Association (GVEA). According to the utility data provided by the school district the effective electricity rate at the schools is $0.20/kWh. The effective electricity rate is the cost of all electric costs (demand, energy, customer charges) per kWH for a billing period. On a BTU basis, electricity is the most expensive energy source.

Existing Fuel Oil Consumption

An estimate of the schools' heating oil consumption was made based on annual heating oil data provided by the FNSB from 2016, and are shown in the following table. Pearl Creek and Weller are the largest consumers of fuel oil.

Table 6 – Existing Fuel Oil Consumption

Building	Fuel Type	Annual Consumption	Net MMBTU/yr	Avg. Annual Cost
Pearl Creek Elementary	Heating Oil #1	15,100 gal	1,315.2	$43,790
Weller Elementary	Heating Oil #1	11,600 gal	1,010.4	$33,640
Two Rivers Elementary	Heating Oil #1	6,800 gal	592.3	$19,720
Salcha Elementary	Heating Oil #1	4,900 gal	426.8	$14,210

Biomass System Consumption

It is estimated that the proposed biomass system at each school will offset approximately 95% of the heating energy for the building. The remaining 5% of the heating energy will be provided by the existing oil boilers. This result is based on an analysis of the school's annual heating oil consumption, the heat output of the pellet boilers and BIN weather data for the area.

It is assumed that two existing oil boilers at each school were designed so that one boiler could reach the peak heating load of the school, with the other boiler as a fully redundant back up. The pellet boilers were selected at ¾ the size of one fuel oil boiler. The only exception is Salcha, where the pellet boiler was selected as the same size as the oil boiler, because there was no smaller pellet boiler option. For Salcha, it is assumed that the pellet boiler will offset 98% of the heating energy, with the remaining 2% coming from the oil boiler during peaking times.

Table 7 – Proposed Biomass System Fuel Consumption

Building	Fuel Type	% Heating Source	Net MMBTU/yr	Annual Consumption	Energy Cost	Total Energy Cost	Annual Energy Savings
Pearl Creek Elementary	Wood Pellets	95%	1249.4	94 tons	$25,873	$28,163	$15,627
	Fuel Oil	5%	65.8	755 gal	$2,190		
	Additional Electricity	N/A	N/A	500 kWh	$100		
Weller Elementary	Wood Pellets	95%	959.8	72 tons	$19,876	$21,628	$12,012
	Fuel Oil	5%	50.5	580 gal	$1,682		
	Additional Electricity	N/A	N/A	350 kWh	$70		
Two Rivers Elementary	Wood Pellets	95%	562.7	42 tons	$11,652	$12,688	$7,032
	Fuel Oil	5%	29.6	340 gal	$986		
	Additional Electricity	N/A	N/A	250 kWh	$50		
Salcha Elementary	Wood Pellets	98%	418.3	31 tons	$8,661	$8,995	$5,215
	Fuel Oil	2%	8.5	98 gal	$284		
	Additional Electricity	N/A	N/A	250 kWh	$50		

Note – Based on wood pellets at $275/ton, heating oil at $2.90/gal and electricity at $0.20/kWh.

6. Preliminary Cost Estimating

An estimate of probable costs was completed for installing the wood pellet boiler systems at each school. The estimate is based equipment quotes and from previous projects in Alaska. Project and Construction Management was estimated at 5%. Engineering design and permitting was estimated at 15% and a 15% contingency was used. Since Fairbanks is on the highway system, an additional remote factor to account for increased shipping costs was not included.

The main cost driver at all schools is the pre-manufactured biomass boiler module. As shown in the following table, the cost of the modules range in price from around $290,000 to $390,000, depending on boiler size.

Table 8 – Estimate of Probable Cost					
	School	**Pearl Creek**	**Weller**	**Two Rivers**	**Salcha**
	Boiler Size	**540kW**	**220kW**	**150kW**	**150kW**
Category	**Description**	**Cost**	**Cost**	**Cost**	**Cost**
Site Work	Site Grading for Module and Silo	$15,000	$4,000	$10,000	$4,000
	Gravel Fill	$10,000	$3,000	$5,000	$5,000
	Module Foundation	$5,000	$5,000	$5,000	$5,000
	Pellet Silo Foundation	$4,000	$4,000	$4,000	$4,000
	Buried Utilities	$8,000	$5,500	$5,000	$5,000
	Subtotal	**$42,000**	**$21,500**	**$29,000**	**$23,000**
Electrical Utilities	Service Entrance	$5,000	$4,500	$4,000	$3,000
	Conduit and Wiring	$6,000	$5,000	$4,000	$3,000
	Subtotal	**$11,000**	**$9,500**	**$8,000**	**$6,000**
Biomass Boiler Module	Module (11.5' W x 10' H x 29' L) including installation of Viessmann RF-300 Pellet Boiler, controller, multi-cyclone, 880gal ASME thermal storage tank, pellet auger, interior piping, valves, electrical, structural components for fully functional boiler module.	$342,594	$254,001	$238,680	$238,680
	R-20 Module Insulation Package	$23,850	$23,850	$23,850	$23,850
	Insulated SS Chimney	$3,982	$3,982	$3,982	$3,982
	Commissioning and Training	$5,200	$5,200	$5,200	$5,200
	Shipping from Enderby, BC to Fairbanks	$10,000	$10,000	$10,000	$10,000
	Pellet Silo (8.5 Ton)	$5,000	$5,000	$5,000	$5,000
	Subtotal	**$390,626**	**$302,033**	**$286,712**	**$286,712**
School Connection	Heat Exchanger	$12,000	$10,000	$8,000	$6,000
	Insulated Pipe from School to Module	$15,000	$8,000	$10,000	$10,000
	Piping Tie-in to Boiler Room	$14,000	$12,000	$10,000	$10,000
	Subtotal	**$41,000**	**$30,000**	**$28,000**	**$26,000**
Subtotal Material and Installation Cost		**$484,626**	**$363,033**	**$351,712**	**$341,712**
Project and Construction Management	5% of subtotal	$24,232	$18,152	$17,586	$17,086
	Subtotal	**$508,858**	**$381,185**	**$369,298**	**$358,798**
Design Fees and Permitting	15% of subtotal of materials and PM	$76,329	$57,178	$55,395	$53,820
	Subtotal	**$585,187**	**$438,363**	**$424,693**	**$412,618**
Contingency	15% of Materials, PM and Design	$87,779	$65,755	$63,704	$61,893
Total Project Cost		$672,966	$504,118	$488,397	$474,511
Total Budgetary Cost		**$673,000**	**$505,000**	**$489,000**	**$475,000**

7. Economic Analysis

The following assumptions were used to complete the economic analysis for this study.

Table 9 – Discount and Escalation rates	
Real Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	3%
O&M Escalation Rate	2%

The real discount rate, or minimum attractive rate of return, is 3.0% and is the current rate used for all Life Cycle Cost Analysis by the Alaska Department of Education and Early Development. This is a typical rate used for completing economic analysis for public entities in Alaska. The escalation rates used for the wood, heating oil, electricity and O&M rates are based on rates used in previous Alaska Energy Authority funded biomass pre-feasibility studies. The wood fuel escalation rate was set at 2%, since there has been limited change in pellet costs in the Fairbanks region.

A net present value analysis was completed using real dollars (constant dollars) and the real discount rate, as required per the Alaska Department of Education and Early Development Life Cycle Cost Analysis Handbook.

O&M Costs

Non-fuel related operations and maintenance costs (O&M) were estimated at $600 per year. The estimate is based on annual maintenance time for Viessman Wood Pellet Boiler. For only the first two years of service, the maintenance cost is doubled to account for maintenance staff getting used to operating the new system.

Definitions

There are many different economic terms used in this study. A listing of all the terms with their definition is provided below for reference.

Table 10 – Economic Definitions	
Economic Term	**Description**
Project Capital Cost	This is the opinion of probable cost for designing and constructing the project.
Present Value of Project Benefits (20-year life)	The present value of all of the heating oil that would have been consumed by the existing heating oil-fired heating system, over a 20-year period.
Present Value of Operating Costs (20-year life)	The present value of all of the proposed biomass systems operating costs over a 20-year period. This includes wood fuel, additional electricity, and O&M costs for the proposed biomass system and the heating oil required by the existing equipment to supply the remaining amount of heat to the building.
Benefit / Cost Ratio of Project (20-year life)	This is the benefit to cost ratio over the 20-year period. A project that has a benefit to cost ratio greater than 1.0 is economically justified. It is defined as follows: $$Benefit\ /\ Cost\ Ratio = \frac{PV(Project\ Benefits) - PV(Operating\ Costs)}{Project\ Capital\ Cost}$$ Where: PV = The present value over the 20-year period Reference Sullivan, Wicks and Koelling, "Engineering Economy", 14th ed., 2009, pg. 440, Modified B-C Ratio.
Net Present Value (20-year life)	This is the net present value of the project over a 20-year period. If the project has a net present value greater than zero, the project is economically justified. This quantity accounts for the project capital cost, project benefits and operating costs.
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	The Payback Period is the number of years it takes for the accumulated cash flow of the project to be greater than or equal to the project capital cost. This quantity includes escalating energy prices and O&M rates. This quantity is calculated as follows: $$Installed\ Cost \leq \sum_{k=0}^{J} R_k$$ Where: J = Year that the accumulated cash flow is greater than or equal to the Project Capital Cost. R_k = Project Cash flow for the kth year.

Results

An economic analysis was completed to determine the simple payback, benefit to cost ratio, and net present value of the proposed wood pellet boiler systems at the elementary schools. At each school, a wood pellet boiler system would be located in a detached module and heating pipes would connect to the new heat exchanger in the school's mechanical room. The wood pellet boiler would supplement heat for the existing oil boiler system. Pellet silos would be located next to the pellet boiler module, and filled by a local pellet supplier.

Due to the low price of heating oil at $2.90/gal, the benefit to cost ratios for each school are less than 1.0. Any project with a benefit to cost ratio less than 1.0 is not considered economically justified, and therefore the wood pellet systems at the schools are not economically justified at this time.

However, historically the price of heating oil has varied greatly over time and as heating oil prices rise the projects can become economically viable. For example, when heating oil reaches $3.50/gal the wood pellet boiler projects at Pearl Creek and Weller become economically justified. This can be seen in the sensitivity analysis on the next page.

The economic analysis shows that wood pellet boiler projects at Pearl Creek and Weller are more economic than at Two Rivers and Salcha. The reason for this is the greater amount of heating oil that can be offset in the larger schools of Pearl Creek and Weller, compared to the cost of the new pellet boiler system. Two Rivers and Salcha are less economic due to the relatively small heating oil offset and high project costs.

The results are shown in the table below. Refer to Appendix B for the economic analysis spreadsheets for greater detail. (Note: Values shown in red and parenthesis are negative numbers)

Table 11 – Economic Analysis Results

Item	Pearl Creek	Weller	Two Rivers	Salcha
Project Capital Cost	($673,000)	($505,000)	($489,000)	($475,000)
Present Value of Project Benefits (20-year life)	$1,027,021	$788,970	$462,500	$333,272
Present Value of Operating Costs (20-year life)	($523,154)	($403,473)	($240,550)	($170,467)
Benefit / Cost Ratio of Project (20-year life)	0.75	0.76	0.45	0.34
Net Present Value (20-year life)	($169,133)	($119,503)	($267,050)	($312,195)
Year Cash Flow is Net Positive	First Year	First Year	First Year	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years	>20 years	>20 years	>20 years

There are other wood pellet boiler manufactures that may reduce overall project costs at the schools. To see how this impacts the economics, a separate analysis was completed where the cost of the fabrication of the biomass boiler module was reduced by 25% (which includes cost of the boiler, pumps, electrical, etc.). The 20-yr benefit to cost ratios for each school with this updated cost are: Pearl Creek (0.91), Weller

(0.93), Two Rivers (0.55), and Salcha (0.42). The economics improve slightly, but all benefit to cost ratios are still below 1.0. For this prefeasibility study, the Viessman boiler basis of design is still used because it gives a more conservative estimate of project costs. During the next phase of engineering design, the project costs can be further refined.

Each school has site constraints that will affect the installation of the project. The projects at both Pearl Creek and Two Rivers have the least impact compared to the other projects because the pellet boiler modules can be installed in undeveloped locations to the east of the schools, but this will increase site development costs. At Weller, the pellet boiler module will either impact the playground, fields or parking lot depending on final location. Salcha has very limited space and the pellet module will impact the parking lot area.

Sensitivity Analysis

A sensitivity analysis was completed to show how changing heating oil costs and wood costs affect the benefit to cost (B/C) ratios of the project. As heating oil costs increase and wood costs decrease, the project becomes more economically viable. The B/C ratios greater than 1.0 are economically justified and are highlighted in green. B/C ratios less than 1.0 are not economically justified and are highlighted in orange.

At a heating oil price of $3.50/gal and the current wood pellet price of $275/ton, the wood pellet boiler projects at both Pearl Creek and Weller are economically justified. This can be seen in the following two tables.

Table 12 – Sensitivity Analysis – Pearl Creek

B/C Ratios		Wood Pellet Cost				
		$225/ton	$250/ton	$275/ton	$300/ton	$325/ton
Heating Oil Cost	$2.75/gal	0.80	0.74	0.67	0.61	0.55
	$3.00/gal	0.92	0.86	0.80	0.74	0.67
	$3.25/gal	1.05	0.99	0.92	0.86	0.80
	$3.50/gal	1.17	1.11	1.05	0.99	0.92
	$3.75/gal	1.30	1.24	1.17	1.11	1.05
	$4.00/gal	1.42	1.36	1.30	1.24	1.17
	$4.25/gal	1.55	1.49	1.42	1.36	1.30
	$4.50/gal	1.67	1.61	1.55	1.49	1.42
	$4.75/gal	1.80	1.74	1.67	1.61	1.55
	$5.00/gal	1.92	1.86	1.80	1.74	1.67
	$5.25/gal	2.05	1.99	1.92	1.86	1.80

Table 13 – Sensitivity Analysis – Weller

B/C Ratios		Wood Pellet Cost				
		$225/ton	$250/ton	$275/ton	$300/ton	$325/ton
Heating Oil Cost	$2.75/gal	0.81	0.75	0.69	0.62	0.56
	$3.00/gal	0.94	0.88	0.81	0.75	0.69
	$3.25/gal	1.07	1.01	0.94	0.88	0.82
	$3.50/gal	1.20	1.13	1.07	1.01	0.94
	$3.75/gal	1.32	1.26	1.20	1.14	1.07
	$4.00/gal	1.45	1.39	1.33	1.26	1.20
	$4.25/gal	1.58	1.52	1.45	1.39	1.33
	$4.50/gal	1.71	1.65	1.58	1.52	1.46
	$4.75/gal	1.84	1.77	1.71	1.65	1.58
	$5.00/gal	1.96	1.90	1.84	1.77	1.71
	$5.25/gal	2.09	2.03	1.97	1.90	1.84

Two Rivers and Salcha become economically justified when heating oil prices reach $4.75/gal and $5.75/gal, respectively, at the current wood pellet price of $275/ton. This can be seen in the following two tables.

Table 14 – Sensitivity Analysis – Two Rivers

B/C Ratios		Wood Pellet Cost				
		$225/ton	$250/ton	$275/ton	$300/ton	$325/ton
Heating Oil Cost	$3.75/gal	0.79	0.76	0.72	0.68	0.64
	$4.00/gal	0.87	0.83	0.79	0.76	0.72
	$4.25/gal	0.95	0.91	0.87	0.83	0.80
	$4.50/gal	1.03	0.99	0.95	0.91	0.87
	$4.75/gal	1.10	1.07	1.03	0.99	0.95
	$5.00/gal	1.18	1.14	1.10	1.07	1.03
	$5.25/gal	1.26	1.22	1.18	1.14	1.11
	$5.50/gal	1.34	1.30	1.26	1.22	1.18
	$5.75/gal	1.41	1.37	1.34	1.30	1.26
	$6.00/gal	1.49	1.45	1.41	1.38	1.34
	$6.25/gal	1.57	1.53	1.49	1.45	1.42

Table 15 – Sensitivity Analysis – Salcha

B/C Ratios		Wood Pellet Cost				
		$225/ton	$250/ton	$275/ton	$300/ton	$325/ton
Heating Oil Cost	$3.75/gal	0.60	0.57	0.54	0.52	0.49
	$4.00/gal	0.66	0.63	0.60	0.57	0.55
	$4.25/gal	0.72	0.69	0.66	0.63	0.60
	$4.50/gal	0.78	0.75	0.72	0.69	0.66
	$4.75/gal	0.84	0.81	0.78	0.75	0.72
	$5.00/gal	0.90	0.87	0.84	0.81	0.78
	$5.25/gal	0.96	0.93	0.90	0.87	0.84
	$5.50/gal	1.02	0.99	0.96	0.93	0.90
	$5.75/gal	1.08	1.05	1.02	0.99	0.96
	$6.00/gal	1.14	1.11	1.08	1.05	1.02
	$6.25/gal	1.19	1.17	1.14	1.11	1.08

8. Forest Resource and Fuel Availability Assessments

Fuel Availability

For this study, the main fuel supplier is the local Fairbanks pellet manufacturer, Superior Pellets. According to discussions with Superior Pellets, they are operating at 15% of capacity and can easily take on 25,000 tons worth of orders without an issue. This is more than enough capacity to meet all the heating demand for the schools studied. No further forest resource assessments were obtained.

Air Quality Permitting

Currently, air quality permitting is regulated according to the Alaska Department of Environmental Conservation Section 18 AAC 50 Air Quality Control regulations. Per these regulations, a minor air quality permit is required if a new wood boiler or wood stove produces one of the following conditions per Section 18 AAC 50.502 (C)(1): 40 tons per year (TPY) of carbon dioxide (CO2), 15 TPY of particulate matter greater than 10 microns (PM-10), 40 TPY of sulfur dioxide, 0.6 TPY of lead, 100 TPY of carbon monoxide within 10 kilometers of a carbon monoxide nonattainment area, or 10 TPY of direct PM-2.5 emissions. These regulations assume that the device will operate 24 hours per day, 365 days per year and that no fuel burning equipment is used. If a new wood boiler or wood stove is installed in addition to a fuel burning heating device, the increase in air pollutants cannot exceed the following per AAC 50.502 (C)(3): 10 TPY of PM-10, 10 TPY of sulfur dioxide, 10 TPY of nitrogen oxides, 100 TPY of carbon monoxide within 10 kilometers of a carbon monoxide nonattainment area, or 10 TPY of direct PM-2.5 emissions. Per the Wood-fired Heating Device Visible Emission Standards (Section 18 AAC 50.075), a person may not operate a wood-fired heating device in a manner that causes black smoke or visible emissions that exceed 50 percent opacity for more than 15 minutes in any hour in an area where an air quality advisory is in effect.

From Coffman's discussions with Patrick Dunn at the Alaska Department of Environmental Conservation, these regulations are focused on permitting industrial applications of wood burning equipment. In his opinion, it would be unlikely that an individual wood boiler would require an air quality permit unless several boilers were to be installed and operated at the same site. If several boilers were installed and operated together, the emissions produced could be greater than 40 tons of CO2 per year. This would require permitting per AAC 50.502 (C)(1) or (C)(3). Permitting would not be required on the residential wood fired stoves unless they violated the Wood-fired Heating Device Visible Emission Standards (Section 18 AAC 50.075). Recent similarly sized Garn wood fired boiler systems installed in Alaska have not required air quality permits.

9. General Biomass Technology Information

Heating with Wood Fuel

Wood fuels are among the most cost-effective and reliable sources of heating fuel for communities adjacent to forestland when the wood fuels are processed, handled, and combusted appropriately. Compared to other heating energy fuels, such as oil and propane, wood fuels typically have lower energy density and higher associated transportation and handling costs. Due to this low bulk density, wood fuels have a shorter viable haul distance when compared to fossil fuels. This short haul distance also creates an advantage for local communities to utilize locally-sourced wood fuels, while simultaneously retaining local energy dollars.

Most communities in rural Alaska are particularly vulnerable to high energy prices due to the large number of heating degree days and expensive shipping costs. For many communities, wood-fueled heating can lower fuel costs. For example, cordwood sourced at $250 per cord is just 25% of the cost per MMBTU as #1 fuel oil sourced at $7 per gallon. In addition to the financial savings, the local communities also benefit from the multiplier effect of circulating energy dollars within the community longer, more stable energy prices, job creation, and more active forest management.

The local cordwood market is influenced by land ownership, existing forest management and ecological conditions, local demand and supply, and the State of Alaska Energy Assistance program.

Types of Wood Fuel

Wood fuels are specified by energy density, moisture content, ash content, and granulometry. Each of these characteristics affects the wood fuel's handling characteristics, storage requirements, and combustion process. Higher quality fuels have lower moisture, ash, dirt, and rock contents, consistent granulometry, and higher energy density. Different types of fuel quality can be used in wood heating projects as long as the infrastructure specifications match the fuel content characteristics. Typically, lower quality fuel will be the lowest cost fuel, but it will require more expensive storage, handling, and combustion infrastructure, as well as additional maintenance.

Projects in rural Alaska must be designed around the availability of wood fuels. Some fuels can be harvested and manufactured on site, such as cordwood, woodchips, and briquettes. Wood pellets can also be used, but typically require a larger scale pellet manufacturer to make them. The economic feasibility of manufacturing on site is determined by a financial assessment of the project. Typically, larger projects offer more flexibility in terms of owning and operating the wood harvesting and manufacturing equipment, such as a wood chipper, splitter, or equipment to haul wood out of forest, than smaller projects.

High Efficiency Wood Pellet Boilers

High efficiency pellet boilers are designed to burn wood pellets cleanly and efficiently. These boilers utilize pellet storage bins or silos that hold a large percentage of the building's annual pellet supply. Augers or vacuums transfer pellets from the silos to a pellet hopper adjacent to the pellet boiler, where pellets can be fed into the boiler for burning. Pellets are automatically loaded into the pellet boiler and do not require manual loading such as in a Garn cordwood boiler. The pellet boilers typically have a 3 to 1 turn down ratio, which allows the firing rate to modulate from 100% down to 33% fire. This allows the boiler to properly match building heat demand, increasing boiler efficiency. The efficiencies of these boilers can range from 85% to 92% efficiency depending on firing rate.

High Efficiency Cordwood Boilers

High Efficiency Low Emission (HELE) cordwood boilers are designed to burn cordwood fuel cleanly and efficiently. The boilers use cordwood that is typically seasoned to 25% moisture content (MC) or less and meet the dimensions required for loading and firing. The amount of cordwood burned by the boiler will depend on the heat load profile of the building and the utilization of the fuel oil system as back up. Two HELE cordwood boiler suppliers include Garn (www.garn.com) and TarmUSA (www.woodboilers.com). Both of these suppliers have units operating in Alaska. TarmUSA has a number of residential units operating in Alaska and has models that range between 100,000 to 300,000 BTU/hr. Garn boilers, manufactured by Dectra Corporation, are used in Tanana, Kasilof, Dot Lake, Thorne Bay, Coffman Cove and other locations to heat homes, washaterias, schools, and community buildings.

The Garn boiler has a unique construction, which is basically a wood boiler housed in a large water tank. Garn boilers come in several sizes and are appropriate for facilities using 100,000 to 1,000,000 BTUs per hour. The jacket of water surrounding the fire box absorbs heat and is piped into buildings via a heat exchanger, and then transferred to an existing building heating system, in-floor radiant tubing, unit heaters, or baseboard heaters. In installations where the Garn boiler is in a detached building, there are additional heat exchangers, pumps and a glycol circulation loop that are necessary to transfer heat to the building while allowing for freeze protection. Radiant floor heating is the most efficient heating method when using wood boilers such as Garns, because they can operate using lower supply water temperatures compared to baseboards.

Garn boilers are approximately 87% efficient and store a large quantity of water. For example, the Garn WHS-2000 holds approximately 1,825 gallons of heated water. Garns also produce virtually no smoke when at full burn, because of a primary and secondary gasification (2,000 ^{o}F) burning process. Garns are manually stocked with cordwood and can be loaded multiple times a day during periods of high heating demand. Garns are simple to operate with only three moving parts: a handle, door and blower. Garns produce very little ash and require minimal maintenance. Removing ash and inspecting fans are typical maintenance requirements. Fans are used to produce a draft that increases combustion temperatures and boiler efficiency. In cold climates, Garns can be equipped with exterior insulated storage tanks for extra hot water circulating capacity. Most facilities using cordwood boilers keep existing oil-fired systems operational to provide heating backup during biomass boiler downtimes and to provide additional heat for peak heating demand periods.

Low Efficiency Cordwood Boilers

Outdoor boilers are categorized as low-efficiency, high emission (LEHE) systems. These boiler systems are not recommended as they produce significant emission issues and do not combust wood fuels efficiently

or completely, resulting in significant energy waste and pollution. These systems require significantly more wood to be purchased, handled and combusted to heat a facility as compared to a HELE system. Additionally, several states have placed a moratorium on installing LEHE boilers because of air quality issues (Washington). These LEHE systems can have combustion efficiencies as low as 25% percent and produce more than nine times the emission rate of standard industrial boilers. In comparison, HELEs can operate around 87% efficiency.

High Efficiency Wood Stoves

Newer high efficiency wood stoves are available on the market that produce minimal smoke, minimal ash and require less firewood. New EPA-certified wood stoves produce significantly less smoke than older uncertified wood stoves. High efficiency wood stoves are easy to operate with minimal maintenance compared to other biomass systems. The Blaze King Classic high efficiency wood stove (www.blazeking.com) is a recommended model, due to its built-in thermostats that monitor the heat output of the stove. This stove automatically adjusts the air required for combustion. This unique technology, combined with the efficiencies of a catalytic combustor with a built-in thermostat, provides the longest burn times of any wood stove. The Blaze King stove allows for optimal combustion and less frequent loading and firing times.

Bulk Fuel Boilers

Bulk fuel boilers usually burn wood chips, sawdust, bark or pellets and are designed around the wood resources that are available from the local forests or local industry. Several large facilities in Tok, Craig, and Delta Junction (Delta Greely High School) are using bulk fuel biomass systems. Tok uses a commercial grinder to process woodchips. The chips are then dumped into a bin and are carried by a conveyor belt to the boiler. The wood fuel comes from timber scraps, local sawmills and forest thinning projects. The Delta Greely High School has a woodchip bulk fuel boiler that heats the 77,000 square foot facility. The Delta Greely system, designed by Coffman engineers, includes a completely separate boiler building which includes a chip storage bunker and space for storage of tractor trailers full of chips (so handling of frozen chips could be avoided). Woodchips are stored in the concrete bunker and augers move the material on a conveyor belt to the boilers.

Grants

There are state, federal, and local grant opportunities for biomass work for feasibility studies, design and construction. If a project is pursued, a thorough search of websites and discussions with the AEA Biomass group is recommended to make sure no possible funding opportunities are missed. Below are some funding opportunities and existing past grants that have been awarded.

The U.S. Department of Agriculture Rural Development has over fifty financial assistance programs for a variety of rural applications. This includes energy efficiency and renewable energy programs.

http://www.rd.usda.gov/programs-services

The city of Nulato was awarded a $40,420 grant for engineering services for a wood energy project by the United States Department of Agriculture (USDA) and the United States Forest Service. Links regarding the award of the Woody Biomass Utilization Project recipients are shown below:

http://www.fs.fed.us/news/2012/releases/07/renewablewoods.shtml

Delta Junction was awarded a grant for engineering from the Alaska Energy Authority from the Renewable Energy Fund for $831,203. This fund provides assistance to utilities, independent power producers, local governments, and tribal governments for feasibility studies, reconnaissance studies, energy resource monitoring, and work related to the design and construction of eligible facilities.

http://www.akenergyauthority.org/Programs/RenewableEnergyFund

The Alaska Wood Energy Development Task Group (AWEDTG) consists of a coalition of federal and state agencies and not-for-profit organizations that have signed a Memorandum of Understanding (MOU) to explore opportunities to increase the utilization of wood for energy and biofuels production in Alaska. A pre-feasibility study for Aleknagik was conducted in 2012 for the AWEDTG. The preliminary costs for the biomass system(s) are $346,257 for the city hall and health center system and $439,096 for the city hall, health center, and future washateria system.

http://www.akenergyauthority.org/Programs/AEEE/Biomass

The Emerging Energy Technology Fund grand program provides funds to eligible applicants for demonstrations projects of technologies that have a reasonable expectation to be commercially viable within five years and that are designed to: test emerging energy technologies or methods of conserving energy, improve an existing energy technology, or deploy an existing technology that has not previously been demonstrated in Alaska.

http://www.akenergyauthority.org/Programs/EETF1

Appendix A
Site Photos

Pearl Creek

1. West Elevation of Building

2. South Elevation of Building

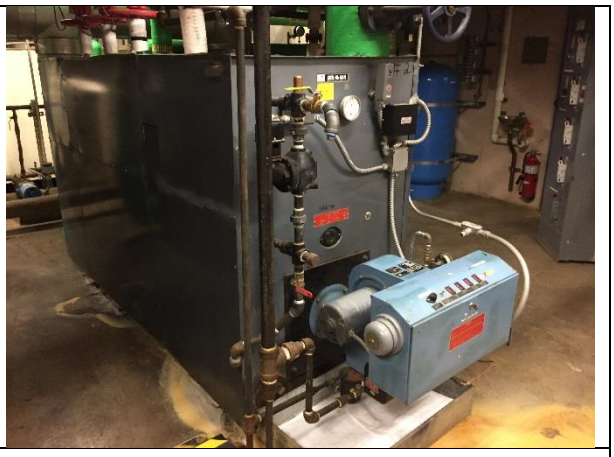
3. North Elevation of Building

4. North Elevation of Building

5. East Elevation of Building

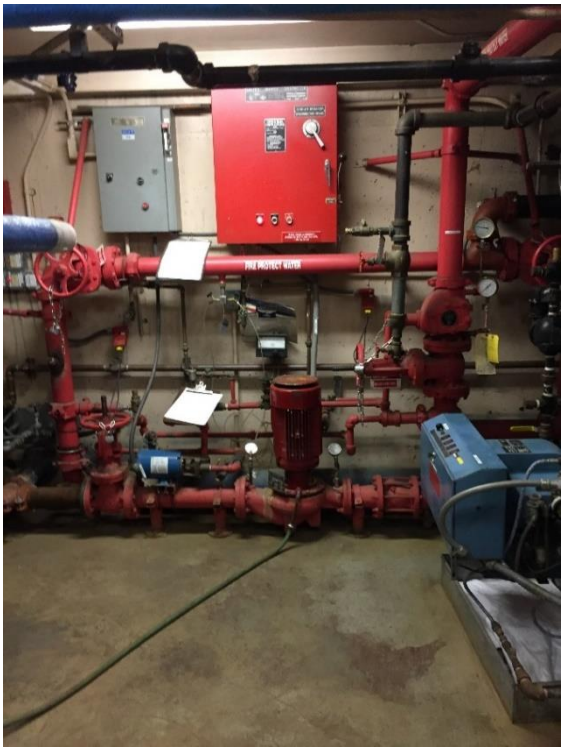
6. Generator

7. Boilers 1 and 2



8. Boiler 2

9. Hot Water Heater



10. Fire Pumps

11. Hydronic Pumps

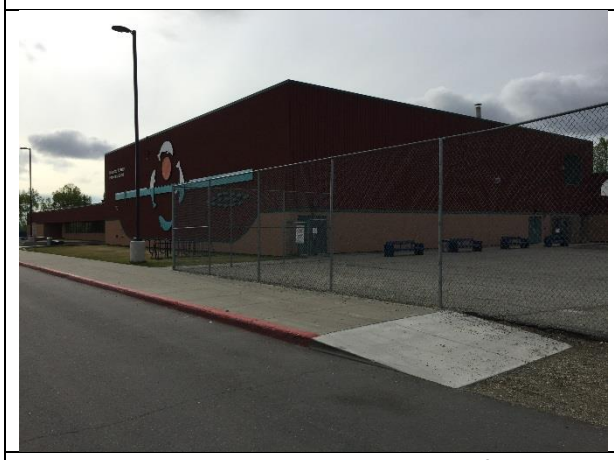
12. Electrical Panels

13. Electrical Panels

Weller

14. North Elevation of Building

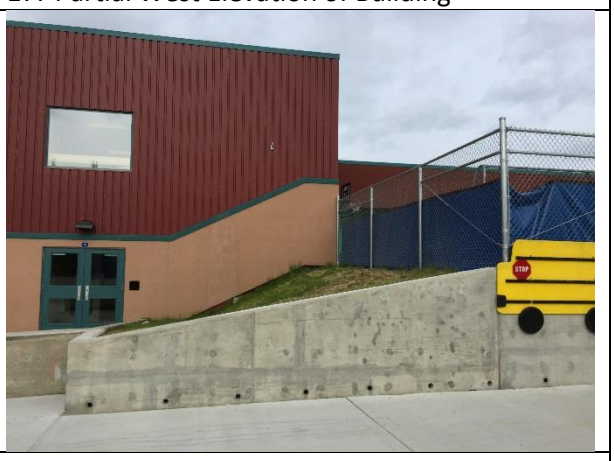
15. Partial North Elevation of Building



16. Partial North and West Elevation of Building

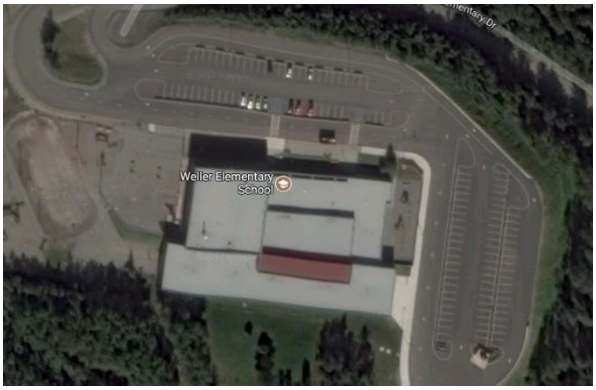
17. Partial West Elevation of Building

18. South Elevation of Building



19. Partial East Elevation of Building

20. Partial East Elevation of Building



21. Building Layout

22. Boilers and Water Heater

23. Well Water Storage Tanks

24. Generator

25. Hydronic Pumps

26. Mechanical Room with Fire Water Tank

27. Parking Lot Head Bolt Electrical Panel

28. Main Electrical Disconnect

29. Electrical Panels

Two Rivers

30. Partial South and East Elevation of Building

31. South Elevation of Building

32. Partial South and West Elevation of Building

33. Partial East and North Elevation of Building

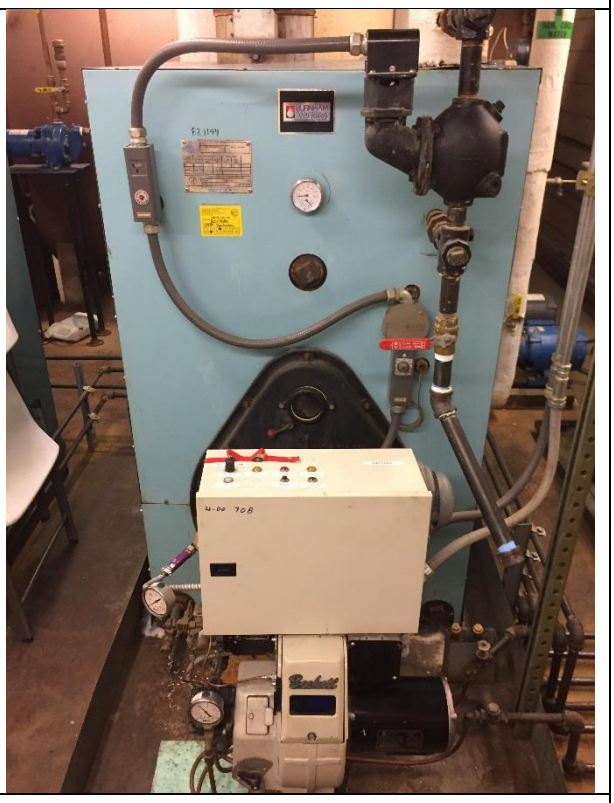
34. Partial East and North Elevation of Building

35. Partial East and North Elevation of Building

36. Building Layout

37. Boilers and Water Heater

38. Boiler 1



39. Boiler 2

40. Hot Water Heater

41. Generator

42. Hauled Water System

43. Well Water System

44. Hauled Water Storage Tanks

45. Hydronic Pumps

46. Pump Motor and Disconnects

47. Electrical Panels for Pump Motors

48. Fuel Oil Pump	

Salcha

49. West Elevation of Building

50. Partial South and West Elevation of Building

51. Partial East and South Elevation of Building

52. Partial East Elevation of Building

53. Partial East Elevation of Building

54. North Elevation of Building

55. Partial West Elevation of Building

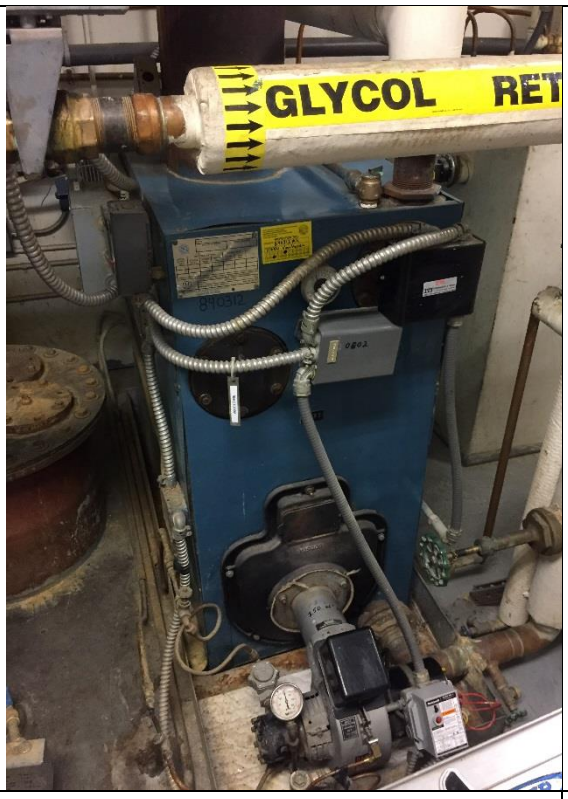
56. Building Layout

57. Boilers and Piping

58. Hot Water Heater

59. Electrical Panels for Pump Motors

60. AHU in second story Mech Room

	
61. Boiler 1	62. Electric Generator

Appendix B
Economic Analysis Spreadsheets

Pearl Creek Elementary School
Fairbanks, Alaska

Economic Analysis Results	
Project Capital Cost	($673,000)
Present Value of Project Benefits (20-year life)	$1,027,021
Present Value of Operating Costs (20-year life)	($523,154)
Benefit / Cost Ratio of Project (20-year life)	0.75
Net Present Value (20-year life)	($169,133)
Year Accumulated Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	2%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	$2.90		15,100	gal	**$43,790**	**$45,980**	**$48,278**	**$50,692**	**$53,227**	**$55,888**	**$58,683**	**$61,617**	**$64,698**	**$67,933**	**$71,329**	**$74,896**	**$78,641**	**$82,573**	**$86,701**	**$91,036**	**$95,588**	**$100,367**	**$105,386**	**$110,655**
Biomass System Operating Costs																								
Wood Pellet Cost (Delivered)	$275.00	95%	94.0	tons	($25,850)	($26,367)	($26,894)	($27,432)	($27,981)	($28,540)	($29,111)	($29,694)	($30,287)	($30,893)	($31,511)	($32,141)	($32,784)	($33,440)	($34,109)	($34,791)	($35,487)	($36,196)	($36,920)	($37,659)
Fossil Fuel	$2.90	5%	755	gal	($2,190)	($2,299)	($2,414)	($2,535)	($2,661)	($2,794)	($2,934)	($3,081)	($3,235)	($3,397)	($3,566)	($3,745)	($3,932)	($4,129)	($4,335)	($4,552)	($4,779)	($5,018)	($5,269)	($5,533)
Additional Electricity	$0.20		500	kWh	($100)	($102)	($104)	($106)	($108)	($110)	($113)	($115)	($117)	($120)	($122)	($124)	($127)	($129)	($132)	($135)	($137)	($140)	($143)	($146)
Operation and Maintenance Costs					($600)	($612)	($624)	($637)	($649)	($662)	($676)	($689)	($703)	($717)	($731)	($746)	($761)	($776)	($792)	($808)	($824)	($840)	($857)	($874)
Additional Operation and Maintenance Costs for first 2 years					($600)	($612)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($29,340)**	**($29,992)**	**($30,037)**	**($30,710)**	**($31,400)**	**($32,108)**	**($32,834)**	**($33,578)**	**($34,342)**	**($35,126)**	**($35,931)**	**($36,756)**	**($37,604)**	**($38,474)**	**($39,367)**	**($40,285)**	**($41,227)**	**($42,195)**	**($43,189)**	**($44,211)**
Annual Operating Cost Savings					$14,451	$15,988	$18,242	$19,983	$21,827	$23,781	$25,849	$28,038	$30,355	$32,806	$35,399	$38,139	$41,037	$44,099	$47,334	$50,752	$54,361	$58,173	$62,197	$66,444
Accumulated Cash Flow					$14,451	$30,438	$48,680	$68,663	$90,490	$114,270	$140,119	$168,158	$198,513	$231,320	$266,718	$304,857	$345,894	$389,993	$437,327	$488,078	$542,440	$600,612	$662,809	$729,253
Net Present Value					**($658,970)**	**($643,901)**	**($627,207)**	**($609,452)**	**($590,624)**	**($570,708)**	**($549,691)**	**($527,557)**	**($504,292)**	**($479,881)**	**($454,308)**	**($427,558)**	**($399,614)**	**($370,460)**	**($340,078)**	**($308,451)**	**($275,562)**	**($241,391)**	**($205,921)**	**($169,133)**

Weller Elementary School
Fairbanks, Alaska

Economic Analysis Results	
Project Capital Cost	($505,000)
Present Value of Project Benefits (20-year life)	$788,970
Present Value of Operating Costs (20-year life)	($403,473)
Benefit / Cost Ratio of Project (20-year life)	0.76
Net Present Value (20-year life)	($119,503)
Year Accumulated Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	2%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	$2.90		11,600	gal	**$33,640**	**$35,322**	**$37,088**	**$38,943**	**$40,890**	**$42,934**	**$45,081**	**$47,335**	**$49,702**	**$52,187**	**$54,796**	**$57,536**	**$60,413**	**$63,433**	**$66,605**	**$69,935**	**$73,432**	**$77,103**	**$80,959**	**$85,007**
Biomass System Operating Costs																								
Wood Pellet Cost (Delivered)	$275.00	95%	72.0	tons	($19,800)	($20,196)	($20,600)	($21,012)	($21,432)	($21,861)	($22,298)	($22,744)	($23,199)	($23,663)	($24,136)	($24,619)	($25,111)	($25,613)	($26,126)	($26,648)	($27,181)	($27,725)	($28,279)	($28,845)
Fossil Fuel	$2.90	5%	580	gal	($1,682)	($1,766)	($1,854)	($1,947)	($2,044)	($2,147)	($2,254)	($2,367)	($2,485)	($2,609)	($2,740)	($2,877)	($3,021)	($3,172)	($3,330)	($3,497)	($3,672)	($3,855)	($4,048)	($4,250)
Additional Electricity	$0.20		350	kWh	($70)	($71)	($73)	($74)	($76)	($77)	($79)	($80)	($82)	($84)	($85)	($87)	($89)	($91)	($92)	($94)	($96)	($98)	($100)	($102)
Operation and Maintenance Costs					($600)	($612)	($624)	($637)	($649)	($662)	($676)	($689)	($703)	($717)	($731)	($746)	($761)	($776)	($792)	($808)	($824)	($840)	($857)	($874)
Additional Operation and Maintenance Costs for first 2 years					($600)	($612)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($22,752)**	**($23,258)**	**($23,151)**	**($23,670)**	**($24,202)**	**($24,747)**	**($25,307)**	**($25,880)**	**($26,469)**	**($27,073)**	**($27,693)**	**($28,329)**	**($28,982)**	**($29,652)**	**($30,340)**	**($31,047)**	**($31,773)**	**($32,518)**	**($33,284)**	**($34,071)**
Annual Operating Cost Savings					$10,888	$12,065	$13,937	$15,272	$16,688	$18,187	$19,774	$21,455	$23,233	$25,114	$27,103	$29,207	$31,431	$33,781	$36,265	$38,888	$41,659	$44,585	$47,675	$50,935
Accumulated Cash Flow					$10,888	$22,953	$36,889	$52,162	$68,849	$87,036	$106,811	$128,265	$151,498	$176,612	$203,715	$232,922	$264,353	$298,135	$334,399	$373,288	$414,947	$459,533	$507,207	$558,143
Net Present Value					**($494,429)**	**($483,057)**	**($470,303)**	**($456,734)**	**($442,339)**	**($427,108)**	**($411,029)**	**($394,093)**	**($376,287)**	**($357,600)**	**($338,020)**	**($317,535)**	**($296,132)**	**($273,798)**	**($250,521)**	**($226,287)**	**($201,082)**	**($174,893)**	**($147,705)**	**($119,503)**

Two Rivers Elementary School
Fairbanks, Alaska

Economic Analysis Results	
Project Capital Cost	($489,000)
Present Value of Project Benefits (20-year life)	$462,500
Present Value of Operating Costs (20-year life)	($240,550)
Benefit / Cost Ratio of Project (20-year life)	0.45
Net Present Value (20-year life)	($267,050)
Year Accumulated Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	2%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	$2.90		6,800	gal	**$19,720**	**$20,706**	**$21,741**	**$22,828**	**$23,970**	**$25,168**	**$26,427**	**$27,748**	**$29,135**	**$30,592**	**$32,122**	**$33,728**	**$35,414**	**$37,185**	**$39,044**	**$40,996**	**$43,046**	**$45,199**	**$47,459**	**$49,831**
Biomass System Operating Costs																								
Wood Pellet Cost (Delivered)	$275.00	95%	42.0	tons	($11,550)	($11,781)	($12,017)	($12,257)	($12,502)	($12,752)	($13,007)	($13,267)	($13,533)	($13,803)	($14,079)	($14,361)	($14,648)	($14,941)	($15,240)	($15,545)	($15,856)	($16,173)	($16,496)	($16,826)
Fossil Fuel	$2.90	5%	340	gal	($986)	($1,035)	($1,087)	($1,141)	($1,198)	($1,258)	($1,321)	($1,387)	($1,457)	($1,530)	($1,606)	($1,686)	($1,771)	($1,859)	($1,952)	($2,050)	($2,152)	($2,260)	($2,373)	($2,492)
Additional Electricity	$0.20		250	kWh	($50)	($51)	($52)	($53)	($54)	($55)	($56)	($57)	($59)	($60)	($61)	($62)	($63)	($65)	($66)	($67)	($69)	($70)	($71)	($73)
Operation and Maintenance Costs					($600)	($612)	($624)	($637)	($649)	($662)	($676)	($689)	($703)	($717)	($731)	($746)	($761)	($776)	($792)	($808)	($824)	($840)	($857)	($874)
Additional Operation and Maintenance Costs for first 2 years					($600)	($612)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($13,786)**	**($14,091)**	**($13,780)**	**($14,088)**	**($14,404)**	**($14,728)**	**($15,061)**	**($15,401)**	**($15,751)**	**($16,110)**	**($16,478)**	**($16,856)**	**($17,243)**	**($17,641)**	**($18,050)**	**($18,469)**	**($18,900)**	**($19,343)**	**($19,798)**	**($20,265)**
Annual Operating Cost Savings					$5,934	$6,615	$7,961	$8,740	$9,566	$10,440	$11,366	$12,347	$13,384	$14,482	$15,644	$16,872	$18,171	$19,544	$20,994	$22,527	$24,146	$25,856	$27,661	$29,567
Accumulated Cash Flow					$5,934	$12,549	$20,510	$29,250	$38,816	$49,256	$60,622	$72,969	$86,353	$100,836	$116,480	$133,352	$151,523	$171,067	$192,061	$214,588	$238,734	$264,590	$292,251	$321,818
Net Present Value					**($483,239)**	**($477,004)**	**($469,718)**	**($461,953)**	**($453,701)**	**($444,958)**	**($435,716)**	**($425,969)**	**($415,711)**	**($404,935)**	**($393,634)**	**($381,800)**	**($369,426)**	**($356,505)**	**($343,030)**	**($328,992)**	**($314,383)**	**($299,195)**	**($283,421)**	**($267,050)**

Salcha Elementary School
Salcha, Alaska

Economic Analysis Results	
Project Capital Cost	($475,000)
Present Value of Project Benefits (20-year life)	$333,272
Present Value of Operating Costs (20-year life)	($170,467)
Benefit / Cost Ratio of Project (20-year life)	0.34
Net Present Value (20-year life)	($312,195)
Year Accumulated Cash Flow is Net Positive	First Year
Payback Period (Year Accumulated Cash Flow > Project Capital Cost)	>20 years

Inflation Rates	
Discount Rate for Net Present Value Analysis	3%
Wood Fuel Escalation Rate	2%
Fossil Fuel Escalation Rate	5%
Electricity Escalation Rate	2%
O&M Escalation Rate	2%

Description	Unit Cost	Heating Source Proportion	Annual Energy Units	Energy Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Existing Heating System Operating Costs																								
Existing Heating Oil Consumption	$2.90		4,900	gal	**$14,210**	**$14,921**	**$15,667**	**$16,450**	**$17,272**	**$18,136**	**$19,043**	**$19,995**	**$20,995**	**$22,044**	**$23,147**	**$24,304**	**$25,519**	**$26,795**	**$28,135**	**$29,542**	**$31,019**	**$32,570**	**$34,198**	**$35,908**
Biomass System Operating Costs																								
Wood Pellet Cost (Delivered)	$275.00	98%	31.0	tons	($8,525)	($8,696)	($8,869)	($9,047)	($9,228)	($9,412)	($9,601)	($9,793)	($9,988)	($10,188)	($10,392)	($10,600)	($10,812)	($11,028)	($11,249)	($11,474)	($11,703)	($11,937)	($12,176)	($12,419)
Fossil Fuel	$2.90	2%	98	gal	($284)	($298)	($313)	($329)	($345)	($363)	($381)	($400)	($420)	($441)	($463)	($486)	($510)	($536)	($563)	($591)	($620)	($651)	($684)	($718)
Additional Electricity	$0.20		250	kWh	($50)	($51)	($52)	($53)	($54)	($55)	($56)	($57)	($59)	($60)	($61)	($62)	($63)	($65)	($66)	($67)	($69)	($70)	($71)	($73)
Operation and Maintenance Costs					($600)	($612)	($624)	($637)	($649)	($662)	($676)	($689)	($703)	($717)	($731)	($746)	($761)	($776)	($792)	($808)	($824)	($840)	($857)	($874)
Additional Operation and Maintenance Costs for first 2 years					($600)	($612)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Operating Costs					**($10,059)**	**($10,269)**	**($9,859)**	**($10,066)**	**($10,277)**	**($10,493)**	**($10,713)**	**($10,939)**	**($11,170)**	**($11,406)**	**($11,647)**	**($11,894)**	**($12,147)**	**($12,405)**	**($12,669)**	**($12,939)**	**($13,216)**	**($13,499)**	**($13,788)**	**($14,084)**
Annual Operating Cost Savings					$4,151	$4,652	$5,808	$6,384	$6,996	$7,643	$8,329	$9,056	$9,825	$10,639	$11,499	$12,410	$13,373	$14,390	$15,466	$16,602	$17,803	$19,071	$20,410	$21,824
Accumulated Cash Flow					$4,151	$8,802	$14,610	$20,994	$27,990	$35,633	$43,962	$53,018	$62,843	$73,482	$84,981	$97,391	$110,763	$125,154	$140,620	$157,222	$175,025	$194,096	$214,506	$236,329
Net Present Value					**($470,970)**	**($466,586)**	**($461,271)**	**($455,598)**	**($449,564)**	**($443,163)**	**($436,390)**	**($429,242)**	**($421,712)**	**($413,796)**	**($405,488)**	**($396,784)**	**($387,678)**	**($378,164)**	**($368,237)**	**($357,891)**	**($347,120)**	**($335,918)**	**($324,279)**	**($312,195)**

Appendix C
AWEDTG Field Data Sheets

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	FNSB		
Eligibility: (check one)	☒ Local government ☐ State agency ☐ Federal agency ☐ School/School District ☐ Federally Recognized Tribe ☐ Regional ANCSA Corp. ☐ Village ANCSA Corp. ☐ Not-for-profit organization ☐ Private Entity that can demonstrate a Public Benefit ☐ Other (describe):		
Contact Name:	Ben Loeffler		
Mailing Address:	1885 Mariko Road		
City:	Fairbanks		
State:	AK	**Zip Code:**	99709
Office phone:	(907) 459-1335	**Cell phone:**	( )
Fax:	(907)		
Email:	bloeffler@fnsb.us		

Facility Identification/Name:	Pearl Creek Elementary	
Facility Contact Person:	SAME AS ABOVE	
Facility Contact Telephone:	(907) SAME	( )
Facility Contact Email:	SAME	

SCHOOL/FACILITY INFORMATION (complete separate Field Data Sheet for each building)

SCHOOL FACILITY (Name: Pearl Creek Elementary **)**

School Type: (check all that apply)	[ ] Pre-School ☒ Elementary [ ] Middle School	[ ] Junior High [ ] High School [ ] Campus	[ ] Student Housing [ ] Pool [ ] Gymnasium	[ ] Other (describe):

Size of facility (sq. ft. heated):	62,982	Year built/age:	1983	
Number of floors:	2	Year(s) renovated:	Unknown	
Number of bldgs.:	1	Next renovation:	Unknown	
# of Students:	500 Students 60 staff	Has en energy audit been conducted?:	Yes	If Yes, when? * 2012

OTHER FACILITY (Name: _____ **)**

Type:	[ ] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [ ] Other (list):

Size of Facility (sq. ft. heated)		Year built/age:	
Number of floors:		Year(s) renovated:	
Number of bldgs.:		Next renovation:	
Frequency of Usage:		# of Occupants	
Has an energy audit been conducted?		If Yes, when? *	

*** If an Energy Audit has been conducted, please provide a copy.**

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- ☒ Heat plant in one location: ☐ on ground level ☒ below ground level ☐ mezzanine ☐ roof ☐ at least 1 exterior wall
- ☐ Different heating plants in different locations: How many? _____ What level(s)? _____
- ☐ Individual room-by-room heating systems (space heaters)
- ☐ Is boiler room accessible to delivery trucks? ☐ Yes ☒ No

HEAT DELIVERY (check all that apply) GLYCOL

- ☒ Hot water: ☒ baseboard ☐ radiant heat floor ☐ cabinet heaters ☒ air handlers ☐ radiators ☐ other: _____
- ☐ Steam: _____
- ☐ Forced/ducted air
- ☐ Electric heat: ☐ resistance ☐ boiler ☐ heat pump(s)
- ☐ Space heaters

HEAT GENERATION (check all that apply)

						Heating capacity (Btuh / kWh) GROSS OUTPUT	Annual Fuel Consumption	Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☒ #1 fuel oil	☐ #2 fuel oil	2 x 2,700 MBH	15,100 gal	$2.90/gal
☐ Steam boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil			
☐ Warm air furnace:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil			
☐ Electric resistance:	☐ baseboard	☐ duct coils						
☐ Heat pumps:	☐ air source	☐ ground source	☐ sea water					
☐ Space heaters:	☐ woodstove	☐ Toyo/Monitor	☐ other: _____					

TEMPERATURE CONTROLS (type of system; check all that apply)

- ☐ Thermostats on individual devices/appliances; no central control system
- ☐ Pneumatic control system Manufacturer: _____ Approx. Age: _____
- ☒ Direct digital control system Manufacturer: Andover / Siemens Approx. Age: Unknown

Record Name Plate data for boilers (use separate sheet if necessary):

2x Weil McLain, BL 1386 S-W, 2,700 MBH GROSS OUTPUT

Describe locations of different parts of the heating system and what building areas are served:

Boiler room located in small space below grade. No easy Access to outside.

Describe age and general condition of existing equipment:

Original 1983. No Access to boiler room to remove boilers.

Who performs boiler maintenance? FNSBSD Maintenance Describe any current maintenance issues: Unknown

Where is piping or ducting routed through the building? (tunnels, utilidors, crawlspace, above false ceiling, attic, etc.):

Through ceilings.

Describe on-site fuel storage: Number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:

Underground fuel tank, 5000 gal, spill containment unknown.

If this fuel is also used for other purposes, please describe:

School Only

DOMESTIC HOT WATER

USES OF DOMESTIC HOT WATER
Check all that apply:

- ☒ Lavatories
- ☒ Kitchen
- ☐ Showers
- ☐ Laundry
- ☐ Water treatment
- ☐ Other: _____

TYPE OF SYSTEM
Check all that apply:

- ☒ Direct-fired, single tank
- ☐ Direct fired, multiple tanks
- ☐ Indirect , using heating boiler with separate storage tank
- ☐ Hot water generator with separate storage tank
- ☐ Other: _____

Bock, 85 gal, Oil-burn. Hot water heater.

What fuels are used to generate hot water? (Check all that apply): ☐ natural gas ☐ propane ☐ electric ☒ #1 fuel oil ☐ #2 fuel oil

Describe location of water heater(s): In boiler room

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:

Same as boilers

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): CMU Block and Metal Stud Insulation Value: ~ R-19 to R-30

Roof type: Built-up flat roof w/ rigid insulation Insulation Value: ~ R-60

Windows: ☐ single pane ☒ double pane ☐ other: _____

Arctic entry(s): ☐ none ☐ at main entrance only ☒ at multiple entrances ☐ at all entrances

Drawings available: ☐ architectural ☒ mechanical ☐ electrical

Outside Air/Air Exchange: ☒ HRV ☐ CO_2 Sensor

ELECTRICAL

Utility company that serves the building or community: GVEA

Type of grid: ☐ building stand-alone ☐ village/community power ☒ railbelt grid

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.20/kWh Demand charge: Effective Rate Used.

Electrical energy phase(s) available: ☐ single phase ☒ 3-phase

Back-up generator on site: ☒ Yes ☐ No If Yes, provide output capacity: 75 kW

Are there spare circuits in MDP and/or electrical panel?: ☐ Yes ☒ No Limited space.

Record MDP and electrical panel name plate information: See photos

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $ 295 /ton Viable fuel source? (Yes) No
- Wood chip cost delivered to facility $ —— /ton Viable fuel source? Yes (No) NOT RECOMMENDED
- Cord wood cost delivered to facility $ —— /cord Viable fuel source? Yes (No) NOT RECOMMENDED
- Distance to nearest wood pellet and wood chip suppliers? Superior Pellets in Fairbanks
- Can logs or wood fuel be stockpiled on site or at a nearby facility? Pellet silo required.

Who manages local forests? Village Native Corp, Regional Native Corp, State of Alaska, Forest Service, BLM, USF&WS, Other:

source will be from pellet manufacturer.

FACILITY SITE CONSIDERATIONS

Is there good access to site for delivery vehicles (trucks, chip vans, etc)? Clearing of trees, new access road and new gravel pad required to access new module.

Are there any significant site constraints? (Playgrounds, other buildings, wetlands, underground utilities, etc.)? The school is on a hill, has buried fuel/water tanks, and playgrounds which make a location diffic

What are local soil conditions? Permafrost issues?

Discontinuous permafrost.

Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close?

No.

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?

No space inside. New module could be placed to the northeast of the gym.

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?

From School.

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?

Yes, but there are other utilities in the area. Pipe could be routed through Gym.

OTHER INFORMATION

Provide any other information that will help describe the space heating and domestic hot water systems, such as

Is heat distribution system looping or branching? Primary loop
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? unknown
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? No
Any systems that could be added to the boiler system? Retro-commissioning
Are heating fuel records available? Yes

PICTURE / VIDEO CHECKLIST

Exterior

- ✓ Main entry
- ✓ Building elevations
- ✓ Several near boiler room and where potential addition/wood storage and/or exterior piping may enter the building
- ✓ Access road to building and to boiler room
- ✓ Power poles serving building
- ✓ Electrical service entry
- ✓ Emergency generator

Interior

- ✓ Boilers, pumps, domestic water heaters, heat exchangers – all mechanical equipment in boiler room and in other parts of the building.
- ✓ Boiler room piping at boiler and around boiler room
- ✓ Piping around domestic water heater
- ✓ MDP and/or electrical panels in or around boiler room
- ✓ Pictures of available circuits in MDP or electrical panel (open door).
- ✓ Picture of circuit card of electrical panel
- ✓ Picture of equipment used to heat room in the building (i.e. baseboard fin tube, unit heaters, unit ventilators, air handler, fan coil)
- ✓ Pictures of any other major mechanical equipment
- ✓ Pictures of equipment using fuel not part of heating or domestic hot water system (kitchen equip., lab equip., pool, etc.)
- ✓ Pictures of building plans (site plan, architectural floor plan, mechanical plan, boiler room plan, electrical power plan)

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	FNSB		
Eligibility: (check one)	☒ Local government ☐ State agency ☐ Federal agency ☐ School/School District ☐ Federally Recognized Tribe ☐ Regional ANCSA Corp. ☐ Village ANCSA Corp. ☐ Not-for-profit organization ☐ Private Entity that can demonstrate a Public Benefit ☐ Other (describe):		
Contact Name:	Ben Loeffler		
Mailing Address:	1885 Manika Rd		
City:			
State:	AK	**Zip Code:**	99709
Office phone:	(907) 459-1335	**Cell phone:**	( )
Fax:	(907)		
Email:	bloeffler@fnsb.us		

Facility Identification/Name:	Weller Elementary	
Facility Contact Person:	Ben Loeffler	
Facility Contact Telephone:	(907) 459-1335	( )
Facility Contact Email:	bloeffler@fnsb.us	

SCHOOL/FACILITY INFORMATION (complete separate Field Data Sheet for each building)

SCHOOL FACILITY (Name: Weller Elementary **)**

School Type: (check all that apply)	[ ] Pre-School ☒ Elementary [ ] Middle School	[ ] Junior High [ ] High School [ ] Campus	[ ] Student Housing [ ] Pool [ ] Gymnasium	[ ] Other (describe):

Size of facility (sq. ft. heated):	65,259	Year built/age:	1983	
Number of floors:	2	Year(s) renovated:	unknown	
Number of bldgs.:	1	Next renovation:	Unknown	
# of Students:	540 students 40 staff	Has en energy audit been conducted?:	Yes	If Yes, when? * 2012

OTHER FACILITY (Name: _____)

Type:	[ ] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [ ] Other (list):

Size of Facility (sq. ft. heated)		Year built/age:	
Number of floors:		Year(s) renovated:	
Number of bldgs.:		Next renovation:	
Frequency of Usage:		# of Occupants	
Has an energy audit been conducted?		If Yes, when? *	

*** If an Energy Audit has been conducted, please provide a copy.**

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply) ON SECOND FLOOR

- ☒ Heat plant in one location: ☐ on ground level ☐ below ground level ☐ mezzanine ☐ roof ☒ at least 1 exterior wall
- ☐ Different heating plants in different locations: How many? _____ What level(s)? _____
- ☐ Individual room-by-room heating systems (space heaters)
- ☐ Is boiler room accessible to delivery trucks? ☐ Yes ☒ No

HEAT DELIVERY (check all that apply) GLYCOL

- ☒ Hot water: ☒ baseboard ☐ radiant heat floor ☐ cabinet heaters ☒ air handlers ☐ radiators ☐ other: _____
- ☐ Steam: _____
- ☐ Forced/ducted air
- ☐ Electric heat: ☐ resistance ☐ boiler ☐ heat pump(s)
- ☐ Space heaters

HEAT GENERATION (check all that apply)

							Heating capacity (Btuh / kWh) GROSS OUTPUT	Annual Fuel Consumption	Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☒ #1 fuel oil	☐ #2 fuel oil		2x1116 MBH	11,600 gal	$2.90/gal
☐ Steam boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Warm air furnace:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Electric resistance:	☐ baseboard	☐ duct coils							
☐ Heat pumps:	☐ air source	☐ ground source	☐ sea water						
☐ Space heaters:	☐ woodstove	☐ Toyo/Monitor	☐ other: _____						

* sourdough/Petrostar is Fuel supplier.

TEMPERATURE CONTROLS (type of system; check all that apply)

- ☐ Thermostats on individual devices/appliances; no central control system
- ☐ Pneumatic control system Manufacturer: _____ Approx. Age: _____
- ☒ Direct digital control system Manufacturer: ANDOVER Approx. Age: UNKNOWN

Record Name Plate data for boilers (use separate sheet if necessary):
2x Burnham, BF-507, 1116 MBH GROSS OUTPUT, SN 7570499 + SN 7570497

Describe locations of different parts of the heating system and what building areas are served:
serves one bldg. Boilers located in second floor mech room.

Describe age and general condition of existing equipment:
OK condition. Appear Original.

Who performs boiler maintenance? FNSBSD Maintenance Describe any current maintenance issues: Unknown.

Where is piping or ducting routed through the building? (tunnels, utilidors, crawlspace, above false ceiling, attic, etc.):
False Cielings

Describe on-site fuel storage: Number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
Underground Fuel Tank, 5000 gal, Secondary containment unknown.

If this fuel is also used for other purposes, please describe:
Only for school

DOMESTIC HOT WATER

USES OF DOMESTIC HOT WATER
Check all that apply:

- ☒ Lavatories
- ☒ Kitchen
- ☐ Showers
- ☒ Laundry
- ☐ Water treatment
- ☐ Other: _____

TYPE OF SYSTEM
Check all that apply:

- ☒ Direct-fired, single tank
- ☐ Direct fired, multiple tanks
- ☐ Indirect , using heating boiler with separate storage tank
- ☐ Hot water generator with separate storage tank
- ☐ Other: _____

Bock 212gal oil-fired water heater.

What fuels are used to generate hot water? (Check all that apply): ☐ natural gas ☐ propane ☐ electric ☒ #1 fuel oil ☐ #2 fuel oil

Describe location of water heater(s): In boiler room

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
Same fuel tank as boilers.

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 2x8 stud + CMU Insulation Value: ~R-26

Roof type: Hot roof w/ metal truss Insulation Value: ~R-35

Windows: ☐ single pane ☒ double pane ☐ other: _____

Arctic entry(s): ☐ none ☐ at main entrance only ☒ at multiple entrances ☐ at all entrances

Drawings available: ☐ architectural ☒ mechanical ☐ electrical

Outside Air/Air Exchange: ☒ HRV ☐ CO_2 Sensor

ELECTRICAL

Utility company that serves the building or community: GVEA

Type of grid: ☐ building stand-alone ☐ village/community power ☒ railbelt grid

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.20/kwh Demand charge: Effective rate used

Electrical energy phase(s) available: ☐ single phase ☒ 3-phase

Back-up generator on site: ☒ Yes ☐ No If Yes, provide output capacity: 100 kW

Are there spare circuits in MDP and/or electrical panel?: ☒ Yes ☐ No

Record MDP and electrical panel name plate information: SEE PHOTOS

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $ 295 /ton Viable fuel source? (Yes) No
- Wood chip cost delivered to facility $ — /ton Viable fuel source? Yes (No)
- Cord wood cost delivered to facility $ — /cord Viable fuel source? Yes (No)

} Not Recommended

- Distance to nearest wood pellet and wood chip suppliers? Superior Pellets in Fairbanks
- Can logs or wood fuel be stockpiled on site or at a nearby facility? Pellet silo required

Who manages local forests? Village Native Corp, Regional Native Corp, State of Alaska, Forest Service, BLM, USF&WS, Other:

Source will be from pellet manufacturer.

FACILITY SITE CONSIDERATIONS

Is there good access to site for delivery vehicles (trucks, chip vans, etc)? There is access around two sides of the building. The other two sides have poor access due to playground + field.

Are there any significant site constraints? (Playgrounds, other buildings, wetlands, underground utilities, etc.)? Playgrounds and views and topography limit space.

What are local soil conditions? Permafrost issues? Discontinuous Permafrost

Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close? No

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go? No space in boiler room. There is space in Raw water storage Room, but no exterior wall access for connect to Pellet silo.

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from? From School.

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room? No good space for out building. Playground on one side. Parking lot on 2 sides. Last side of building is view shed of classrooms and septic line utilities.

OTHER INFORMATION

Provide any other information that will help describe the space heating and domestic hot water systems, such as

Is heat distribution system looping or branching? Looping. Primary pumps only.
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? Unknown
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? No
Any systems that could be added to the boiler system? Retrocomissioning
Are heating fuel records available? Yes.

PICTURE / VIDEO CHECKLIST

Exterior

- ✓ Main entry
- ✓ Building elevations
- ✓ Several near boiler room and where potential addition/wood storage and/or exterior piping may enter the building
- ✓ Access road to building and to boiler room
- ✓ Power poles serving building
- ✓ Electrical service entry
- ✓ Emergency generator

Interior

- ✓ Boilers, pumps, domestic water heaters, heat exchangers – all mechanical equipment in boiler room and in other parts of the building.
- ✓ Boiler room piping at boiler and around boiler room
- ✓ Piping around domestic water heater
- ✓ MDP and/or electrical panels in or around boiler room
- ✓ Pictures of available circuits in MDP or electrical panel (open door).
- ✓ Picture of circuit card of electrical panel
- ✓ Picture of equipment used to heat room in the building (i.e. baseboard fin tube, unit heaters, unit ventilators, air handler, fan coil)
- ✓ Pictures of any other major mechanical equipment
- ✓ Pictures of equipment using fuel not part of heating or domestic hot water system (kitchen equip., lab equip., pool, etc.)
- Pictures of building plans (site plan, architectural floor plan, mechanical plan, boiler room plan, electrical power plan)

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT **FIELD DATA SHEET**

APPLICANT:	FNSB
Eligibility: (check one)	☒ Local government ☐ State agency ☐ Federal agency ☐ School/School District ☐ Federally Recognized Tribe ☐ Regional ANCSA Corp. ☐ Village ANCSA Corp. ☐ Not-for-profit organization ☐ Private Entity that can demonstrate a Public Benefit ☐ Other (describe):
Contact Name:	Ben Loeffler
Mailing Address:	1885 Marika Rd
City:	Fairbanks
State:	AK **Zip Code:** 99709
Office phone:	(907) 459-1335 **Cell phone:** ( )
Fax:	(907)
Email:	bloeffler@fnsb.us

Facility Identification/Name:	Two Rivers Elementary	
Facility Contact Person:	SAME AS ABOVE	
Facility Contact Telephone:	(907) SAME	( )
Facility Contact Email:	SAME	

SCHOOL/FACILITY INFORMATION (complete separate Field Data Sheet for each building)

SCHOOL FACILITY (Name: Two Rivers Elementary **)**

School Type: (check all that apply)	[ ] Pre-School ☒ Elementary [ ] Middle School	[ ] Junior High [ ] High School [ ] Campus	[ ] Student Housing [ ] Pool [ ] Gymnasium	[ ] Other (describe):

Size of facility (sq. ft. heated):	22,200 SF	Year built/age:	1982	
Number of floors:	2	Year(s) renovated:	Unknown	
Number of bldgs.:	1	Next renovation:	Controls upgrade 2017	
# of Students:	90 students 20 staff	Has en energy audit been conducted?:	Yes	If Yes, when? * 2012

OTHER FACILITY (Name: _____ **)**

Type:	[ ] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [ ] Other (list):

Size of Facility (sq. ft. heated)		Year built/age:	
Number of floors:		Year(s) renovated:	
Number of bldgs.:		Next renovation:	
Frequency of Usage:		# of Occupants	
Has an energy audit been conducted?		If Yes, when? *	

*** If an Energy Audit has been conducted, please provide a copy.**

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- ☒ Heat plant in one location: ☑ on ground level ☒ below ground level ☐ mezzanine ☐ roof ☐ at least 1 exterior wall
- ☐ Different heating plants in different locations: How many? _____ What level(s)? _____
- ☐ Individual room-by-room heating systems (space heaters)
- ☐ Is boiler room accessible to delivery trucks? ☐ Yes ☒ No

HEAT DELIVERY (check all that apply)

- ☒ Hot water: ☒ baseboard ☐ radiant heat floor ☐ cabinet heaters ☒ air handlers ☐ radiators ☐ other: _____ GLYCOL
- ☐ Steam: _____
- ☐ Forced/ducted air
- ☐ Electric heat: ☐ resistance ☐ boiler ☐ heat pump(s)
- ☐ Space heaters

HEAT GENERATION (check all that apply)

							Heating capacity (Btuh / kWh) GROSS OUTPUT	Annual Fuel Consumption	Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☒ #1 fuel oil	☐ #2 fuel oil		2x 786 MBH	6,800 gal	$2.90/gal
☐ Steam boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Warm air furnace:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Electric resistance:	☐ baseboard	☐ duct coils							
☐ Heat pumps:	☐ air source	☐ ground source	☐ sea water						
☐ Space heaters:	☐ woodstove	☐ Toyo/Monitor	☐ other: _____						

TEMPERATURE CONTROLS (type of system; check all that apply)

- ☐ Thermostats on individual devices/appliances; no central control system
- ☐ Pneumatic control system Manufacturer: _____ Approx. Age: _____
- ☒ Direct digital control system Manufacturer: Siemens Approx. Age: In process of being upgraded in summer 2017.

Record Name Plate data for boilers (use separate sheet if necessary):

2x Burnham, PF-505, 786 MBH GROSS OUTPUT, SN 7573310 & SN 7571887

Describe locations of different parts of the heating system and what building areas are served:

Boilers located in below grade room.

Describe age and general condition of existing equipment:

OK condition. Original.

Who performs boiler maintenance? FNSBSD Maintenance Describe any current maintenance issues: Unknown

Where is piping or ducting routed through the building? (tunnels, utilidors, crawlspace, above false ceiling, attic, etc.):

Cieling space.

Describe on-site fuel storage: Number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:

Underground, 5000 gal tank, secondary containment unknown.

If this fuel is also used for other purposes, please describe:

Just for school

DOMESTIC HOT WATER

USES OF DOMESTIC HOT WATER
Check all that apply:

- ☒ Lavatories
- ☐ Kitchen
- ☐ Showers
- ☐ Laundry
- ☐ Water treatment
- ☐ Other: _____

TYPE OF SYSTEM
Check all that apply:

Bock, 135 gal, oil-fire water heater.

- ☒ Direct-fired, single tank
- ☐ Direct fired, multiple tanks
- ☐ Indirect , using heating boiler with separate storage tank
- ☐ Hot water generator with separate storage tank
- ☐ Other: _____

What fuels are used to generate hot water? (Check all that apply): ☐ natural gas ☐ propane ☐ electric ☒ #1 fuel oil ☐ #2 fuel oil

Describe location of water heater(s): In boiler room

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
Same as boiler.

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 2x8 stud and CMU Insulation Value: R-25

Roof type: Hot Roof Insulation Value: R-50

Windows: ☐ single pane ☒ double pane ☐ other: _____

Arctic entry(s): ☐ none ☒ at main entrance only ☐ at multiple entrances ☐ at all entrances

Drawings available: ☐ architectural ☒ mechanical ☐ electrical

Outside Air/Air Exchange: ☒ HRV ☐ CO_2 Sensor

ELECTRICAL

Utility company that serves the building or community: GVEA

Type of grid: ☐ building stand-alone ☐ village/community power ☒ railbelt grid

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.20/kWh Demand charge: Effective Rate Used

Electrical energy phase(s) available: ☐ single phase ☒ 3-phase

Back-up generator on site: ☒ Yes ☐ No If Yes, provide output capacity: 30 kW

Are there spare circuits in MDP and/or electrical panel?: ☒ Yes ☐ No

Record MDP and electrical panel name plate information:

SEE PHOTOS FOR PANELS

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $ 295 /ton Viable fuel source? (Yes) No
- Wood chip cost delivered to facility $ — /ton Viable fuel source? Yes (No)
- Cord wood cost delivered to facility $ — /cord Viable fuel source? Yes (No)

} NOT RECOMMENDED

- Distance to nearest wood pellet and wood chip suppliers? Superior Pellets in Fairbanks
- Can logs or wood fuel be stockpiled on site or at a nearby facility? Pellet silo required

Who manages local forests? Village Native Corp, Regional Native Corp, State of Alaska, Forest Service, BLM, USF&WS, Other:

Source will be pellet manufacturer.

FACILITY SITE CONSIDERATIONS

Is there good access to site for delivery vehicles (trucks, chip vans, etc)?
Good access on north side of school
Are there any significant site constraints? (Playgrounds, other buildings, wetlands, underground utilities, etc.)?
Playgrounds and fields on west, south and east sides of school.
What are local soil conditions? Permafrost issues?
Discontinuous Permafrost
Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close?
No.
Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?
No room inside. Northeast storage room upstairs could work, but will be tight. New module could go in new gravel pad North east of school.
Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?
From School
If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?
Piping could run underground, enter second floor and drop into mech room

OTHER INFORMATION

Provide any other information that will help describe the space heating and domestic hot water systems, such as

Is heat distribution system looping or branching? Primary loop
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? Unknown
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? No.
Any systems that could be added to the boiler system? Retrocommissioning
Are heating fuel records available? Yes

PICTURE / VIDEO CHECKLIST

Exterior
- ✓ Main entry
- ✓ Building elevations
- ✓ Several near boiler room and where potential addition/wood storage and/or exterior piping may enter the building
- ✓ Access road to building and to boiler room
- ✓ Power poles serving building
- ✓ Electrical service entry
- ✓ Emergency generator

Interior
- ✓ Boilers, pumps, domestic water heaters, heat exchangers – all mechanical equipment in boiler room and in other parts of the building.
- ✓ Boiler room piping at boiler and around boiler room
- ✓ Piping around domestic water heater
- ✓ MDP and/or electrical panels in or around boiler room
- ✓ Pictures of available circuits in MDP or electrical panel (open door).
- ✓ Picture of circuit card of electrical panel
- ✓ Picture of equipment used to heat room in the building (i.e. baseboard fin tube, unit heaters, unit ventilators, air handler, fan coil)
- ✓ Pictures of any other major mechanical equipment
- ✓ Pictures of equipment using fuel not part of heating or domestic hot water system (kitchen equip., lab equip., pool, etc.)
- ✓ Pictures of building plans (site plan, architectural floor plan, mechanical plan, boiler room plan, electrical power plan)

ALASKA WOOD ENERGY DEVELOPMENT TASK GROUP (AWEDTG)

PRE-FEASIBILITY ASSESSMENT FIELD DATA SHEET

APPLICANT:	FNSB		
Eligibility: (check one)	☒ Local government ☐ State agency ☐ Federal agency ☐ School/School District ☐ Federally Recognized Tribe ☐ Regional ANCSA Corp. ☐ Village ANCSA Corp. ☐ Not-for-profit organization ☐ Private Entity that can demonstrate a Public Benefit ☐ Other (describe):		
Contact Name:	Ben Loeffler		
Mailing Address:	1885 Marika Rd		
City:	Fairbanks		
State:	AK	**Zip Code:**	99709
Office phone:	(907) 459-1335	**Cell phone:**	( )
Fax:	(907)		
Email:	bloeffler@fnsb.us		

Facility Identification/Name:	Salcha Elementary	
Facility Contact Person:	Same as above	
Facility Contact Telephone:	(907) SAME	( )
Facility Contact Email:	SAME	

SCHOOL/FACILITY INFORMATION (complete separate Field Data Sheet for each building)

SCHOOL FACILITY (Name: Salcha Elementary **)**

School Type: (check all that apply)	[ ] Pre-School [ ] Elementary [ ] Middle School	[ ] Junior High [ ] High School [ ] Campus	[ ] Student Housing [ ] Pool [ ] Gymnasium	[ ] Other (describe):

Size of facility (sq. ft. heated):	13,608 SF	Year built/age:	1963	
Number of floors:	1	Year(s) renovated:	2015, 1984	
Number of bldgs.:	1 main bldg	Next renovation:	None	
# of Students:	88 students 9 staff	Has en energy audit been conducted?:	Yes	If Yes, when? * 2012

OTHER FACILITY (Name: _____ **)**

Type:	[ ] Health Clinic [ ] Public Safety Bldg. [ ] Community Center	[ ] Water Plant [ ] Washeteria [ ] Public Housing	[ ] Multi-Purpose Bldg [ ] District Energy System [ ] Other (list):

Size of Facility (sq. ft. heated)		Year built/age:	
Number of floors:		Year(s) renovated:	
Number of bldgs.:		Next renovation:	
Frequency of Usage:		# of Occupants	
Has an energy audit been conducted?		If Yes, when? *	

*** If an Energy Audit has been conducted, please provide a copy.**

HEATING SYSTEM INFORMATION

CONFIGURATION (check all that apply)

- ☒ Heat plant in one location: ☒ on ground level ☐ below ground level ☐ mezzanine ☐ roof ☒ at least 1 exterior wall
- ☐ Different heating plants in different locations: How many? _____ What level(s)? _____
- ☐ Individual room-by-room heating systems (space heaters)
- ☐ Is boiler room accessible to delivery trucks? ☐ Yes ☒ No

HEAT DELIVERY (check all that apply)

- ☒ Hot water: ☒ baseboard ☒ radiant heat floor ☒ cabinet heaters ☒ air handlers ☐ radiators ☐ other: _____ GLYCOL
- ☐ Steam: _____
- ☐ Forced/ducted air
- ☐ Electric heat: ☐ resistance ☐ boiler ☐ heat pump(s)
- ☐ Space heaters

HEAT GENERATION (check all that apply)

							Heating capacity (Btuh / kWh) GROSS OUTPUT	Annual Fuel Consumption	Cost
☒ Hot water boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil		2x 438 MBH	4,900 gal	
☐ Steam boiler:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Warm air furnace:	☐ natural gas	☐ propane	☐ electric	☐ #1 fuel oil	☐ #2 fuel oil				
☐ Electric resistance:	☐ baseboard	☐ duct coils							
☐ Heat pumps:	☐ air source	☐ ground source	☐ sea water						
☐ Space heaters:	☐ woodstove	☐ Toyo/Monitor	☐ other: _____						

TEMPERATURE CONTROLS (type of system; check all that apply)

- ☐ Thermostats on individual devices/appliances; no central control system
- ☐ Pneumatic control system Manufacturer: _____ Approx. Age: _____
- ☒ Direct digital control system Manufacturer: ANDOVER Approx. Age: UNKNOWN

Record Name Plate data for boilers (use separate sheet if necessary):

Nameplate Data

Describe locations of different parts of the heating system and what building areas are served:

Boilers in mechanical room serves full school.

Describe age and general condition of existing equipment:

1984 heating system.

Who performs boiler maintenance? ENSBSD Maintenance Describe any current maintenance issues: Unknown

2x Burnham, V-38, 438 MBH GROSS OUTPUT, SN 7580597 + SN 7580650

Where is piping or ducting routed through the building? (tunnels, utilidors, crawlspace, above false ceiling, attic, etc.):

Cieling routing

Describe on-site fuel storage: Number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:

Underground tank, 3000 gal, secondary containment unknown.

If this fuel is also used for other purposes, please describe:

Only for school

DOMESTIC HOT WATER

USES OF DOMESTIC HOT WATER
Check all that apply:

- ☒ Lavatories
- ☒ Kitchen
- ☐ Showers
- ☐ Laundry
- ☐ Water treatment
- ☐ Other: _____

TYPE OF SYSTEM
Check all that apply:

Bock, 50gal, Oil-Fired Water Heater

- ☒ Direct-fired, single tank
- ☐ Direct fired, multiple tanks
- ☐ Indirect , using heating boiler with separate storage tank
- ☐ Hot water generator with separate storage tank
- ☐ Other: _____

What fuels are used to generate hot water? (Check all that apply): ☐ natural gas ☐ propane ☐ electric ☒ #1 fuel oil ☐ #2 fuel oil

Describe location of water heater(s): In boiler room

Describe on-site fuel storage: number of tanks, size of tanks, location(s) of tanks, condition, spill containment, etc.:
Same tank as boilers.

BUILDING ENVELOPE

Wall type (stick frame, masonry, SIP, etc.): 2x6 & 2x12 stud Insulation Value: R-19 & R-38

Roof type: Hot Roof Insulation Value: ~R-60

Windows: ☐ single pane ☒ double pane ☐ other: _____

Arctic entry(s): ☐ none ☐ at main entrance only ☒ at multiple entrances ☐ at all entrances

Drawings available: ☐ architectural ☒ mechanical ☐ electrical

Outside Air/Air Exchange: ☐ HRV ☐ CO_2 Sensor

ELECTRICAL

Utility company that serves the building or community: GVEA

Type of grid: ☐ building stand-alone ☐ village/community power ☒ railbelt grid

Energy source: ☐ hydropower ☒ diesel generator(s) ☐ Other: _____

Electricity rate per kWh: $0.20/kWh Demand charge: Effective Rate Used

Electrical energy phase(s) available: ☐ single phase ☒ 3-phase

Back-up generator on site: ☒ Yes ☐ No If Yes, provide output capacity: 30 KW

Are there spare circuits in MDP and/or electrical panel?: ☒ Yes ☐ No

Record MDP and electrical panel name plate information: see photos for panels

WOOD FUEL INFORMATION

- Wood pellet cost delivered to facility $ 295 /ton Viable fuel source? (Yes) No
- Wood chip cost delivered to facility $ — /ton Viable fuel source? Yes (No) NOT RECOMMENDED
- Cord wood cost delivered to facility $ — /cord Viable fuel source? Yes (No)
- Distance to nearest wood pellet and wood chip suppliers? Superior Pellets in Fairbanks
- Can logs or wood fuel be stockpiled on site or at a nearby facility? Pellet Silo required

Who manages local forests? Village Native Corp, Regional Native Corp, State of Alaska, Forest Service, BLM, USF&WS, Other:

Source from pellet manufacturer.

FACILITY SITE CONSIDERATIONS

Is there good access to site for delivery vehicles (trucks, chip vans, etc)?

Poor access. Not alot of space. Only access is parking lot

Are there any significant site constraints? (Playgrounds, other buildings, wetlands, underground utilities, etc.)?

Playground, ski trails, septic system, fire water pump house.

What are local soil conditions? Permafrost issues?

Discontinuous Permafrost

Is the building in proximity to other buildings with biomass potential? If so, Which ones and How close?

Music Room portable and ski Hut. 160 ft away.

Can building accommodate a biomass boiler inside, or would an addition for a new boiler be necessary? Where would addition go?

No space inside the school. A new module is needed. Very limited space. It could go to west of Fire pump module at edge of parking lot (30 ft away from school)

Where would potential boiler plant or addition utilities (water/sewer/power/etc.) come from?

From School

If necessary, can piping be run underground from a central plant to the building? Where would piping enter boiler room?

Piping could be run underground. There is already insulated buried hydronic piping from school to Fire Pump Module. New lines would be required.

OTHER INFORMATION

Provide any other information that will help describe the space heating and domestic hot water systems, such as

Is heat distribution system looping or branching? Primary/secondary
For baseboard hydronic heat, what is the diameter of the copper tubing? Size of fins? Number of fins per lineal foot? unknown
Any other energy using systems (kitchen equipment, lab equipment, pool etc)? Fuel or energy source? No
Any systems that could be added to the boiler system? Retrocommissioning
Are heating fuel records available? Yes

PICTURE / VIDEO CHECKLIST

Exterior

- ✓ Main entry
- ✓ Building elevations
- ✓ Several near boiler room and where potential addition/wood storage and/or exterior piping may enter the building
- ✓ Access road to building and to boiler room
- ✓ Power poles serving building
- ✓ Electrical service entry
- ✓ Emergency generator

Interior

- ✓ Boilers, pumps, domestic water heaters, heat exchangers – all mechanical equipment in boiler room and in other parts of the building.
- ✓ Boiler room piping at boiler and around boiler room
- ✓ Piping around domestic water heater
- ✓ MDP and/or electrical panels in or around boiler room
- ✓ Pictures of available circuits in MDP or electrical panel (open door).
- ✓ Picture of circuit card of electrical panel
- ✓ Picture of equipment used to heat room in the building (i.e. baseboard fin tube, unit heaters, unit ventilators, air handler, fan coil)
- ✓ Pictures of any other major mechanical equipment
- ✓ Pictures of equipment using fuel not part of heating or domestic hot water system (kitchen equip., lab equip., pool, etc.)
- ✓ Pictures of building plans (site plan, architectural floor plan, mechanical plan, boiler room plan, electrical power plan)