Port Graham Community Building Biomass Heating Design Project—DE-EE0005637—CFDA No. 81.087

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Acronym Page

AEA	State of Alaska Alaska Energy Authority
BIA	U. S. Bureau of Indian Affairs
DOE	U. S. Department of Energy Tribal Energy Program
PGVC	Port Graham Village Corporation/ Port Graham Development Corporation
NVPG	Native Village of Port Graham the federal recognized Tribe of Port Graham, Alaska and community administrator

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1. Introduction

Native Village of Port Graham completed preconstruction activities to prepare for construction and operations of a cord wood biomass heating system to five or more community buildings in Port Graham, Alaska.

2. Executive Summary

Project Description

Native Village of Port Graham (NVPG) completed preconstruction activities that pave the way towards reduced local energy costs through the construction and operations of a cord wood biomass heating system. NVPG plans include installation of a GARN WHS 3200 Boiler that uses cord wood as fuel source. Implementation of the 700,000 Btu per hour output biomass community building heat utility would heat 5-community buildings in Port Graham, Alaska. Heating system is estimated to displace 85% of the heating fuel oil or 5365 gallons of fuel on an annual basis with an estimated peak output of 600,000 Btu per hour. Estimated savings is $15,112.00 per year.

The construction cost estimate made to install the new biomass boiler system is estimated $251,693.47 with an additional Boiler Building expansion cost estimated at $97,828.40. Total installed cost is estimated $349,521.87. The WHS 3200 Boiler would be placed inside a new structure at the old community Water Plant Building site that is controlled by NVPG. Design of the new biomass heat plant and hot water loop system was completed by Richmond Engineering, NVPG contractor for the project. A hot water heat loop system running off the boiler is designed to be placed underground on lands controlled by NVPG and stubbed to feed hot water to existing base board heating system in the following community buildings:

1. Anesia Anahonak Moonin Health and Dental Clinic
2. Native Village of Port Graham offices
3. Port Graham Public Safety Building/Fire Department
4. Port Graham Corporation Office Building which also houses the Port Graham Museum and Head Start Center
5. North Pacific Rim Housing Authority Workshop/Old Fire Hall

Existing community buildings fuel oil heating systems are to be retro-fitted to accommodate hot water from the proposed wood-burning GARN Boiler, once installed, and rely on the existing fuel oil-fired hot water heating equipment for backup.

The boiler would use an estimated 125 bone dry tons, equivalent to 100 cords, woody biomass feedstock obtained from local lands per year. Project would use local labor as described in the *Port Graham Biomass Project*, report completed by Chena Power, Inc. and Winters and Associates as part of the in-kind support to the U. S. Department of Energy (DOE) project for work on a project for State of Alaska's Alaska Energy Authority (AEA).

NVPG will likely initiate operations of the biomass boiler system even though several operational variations were studied. Obtaining the fuel source could be done by contractors, PGVC employees, or NVPG employees. Feeding the system would likely be done by NVPG employees.

A majority of the buildings heated would be owned by NVPG. The PGVC office would be heated as well as the Old Fire Hall used as a workshop and storage area for North Pacific Rim Housing Authority. One methodology studied to charge for cost of utilizing the community building biomass system would use a percentage of use of hot water generated by the biomass hot water system based on past heating oil usage in relation to all buildings heated by biomass hot water. The method is better described in the *Port Graham Biomass Project* report.

Fuel source agreements have been drafted to enter into agreements with area landowners. One Native allotment owner has asked Chugachmiut Forestry to begin a timber sale process to sell timber off her lands, specifically wind thrown timber that was determined to be of sufficient quantity to supply to the proposed biomass heating system for approximately 5-years. On NVPG's behalf, Chugachmiut has presented to PGVC three different documents, attached, that could lead to a sale of woody biomass fuel for the project for up to 25-years, the expected life of the project. PGVC has signed a letter of intent to negotiate a sale of woody biomass material April 30, 2015.

Chugachmiut Forestry has conducted two different field forest measurements of Native allotment lands and PGVC forest and timber lands. Lands deemed road accessible for biomass harvest were analyzed for this project. Forestry then conducted three different analyses and developed two reports to determine forest biomass on a tons per acre basis in addition to timber volume measurements taken for forest management purposes.

Permits required were limited. For the biomass building, the Kenai Peninsula Borough did not require a permit. State of Alaska, Department of Public Safety, Division of Fire and Life Safety requires a plan review for fire and life safety requirements called an application for *Fire and Life Safety Plan Review* that would require a registered design professional to sign the document. State of Alaska State Forest Practices Act is required to be followed for any timber sale or harvest. This Act also requires consultation with

Alaska Department of Fish and Game when operations are in close proximity or cross anadromous waters. Native allotment lands require following U. S. Bureau of Indian Affairs timber sale contracting process and approval.

Figure 1 Port Graham, Alaska Location Map

3. Demographic

Project Location – Port Graham, Alaska is located on the southwestern tip of the Kenai Peninsula, in a region known as South Central Alaska and south of Kachemak Bay. See Figure 1 *Port Graham, Alaska Location Map*. Port Graham is the second to last village on the peninsula and is located approximately 28 air miles south of Homer, Alaska. The closest neighboring village is the Native Village of Nanwalek that is located 4.5 miles to the west. The only access to Port Graham is by air or water. Nanwalek and Port Graham are only connected by a foot trail.

Port Graham community is predominately of Alutiiq Sugpiaq heritage where approximately 90.4% of the residents are Alaskan native. One hundred seventy seven (177)[1] people reside in the Native Village of Port Graham overlooking Cook Inlet. Native Village of Port Graham is the federally recognized Alaska Native tribal council. The community is administered by the tribal council and desires to maintain their cultural identity and ties. Many members participate in traditional hunting, fishing, and gathering methods while observing cultural traditions.

Primary employment sources are local tribal, corporation, and public sector, the school and health clinic. The U.S. Census Bureau 2006-2010 American Community Survey estimates 32 Port Graham residents as employed; the local unemployment rate in Port Graham is 22.0% with another 44.6% of the population are out of the labor force (unemployed and not seeking employment). The average median household income in Port Graham is $18,942.[2]

Households and community buildings in the target area rely, heavily on single-phase electricity and heating diesel fuel for energy services. All community facilities but one are wood structures with metal roofs and are either on wood, concrete, or concrete block foundations. These buildings are currently heated with diesel-fired, hot-water systems to each individual building. Community of Port Graham encompasses 5.9 square miles of land. Adjacent Native village corporation and Alaska native allotment lands extend approximately 20-miles from the community along an existing road system.

4. Project Goals and Objectives

Provide a comparison of the actual accomplishments with the goals and objectives of the project.

[1] 2010 US Census
[2] *Port Graham Biomass Project*, Nadine Winters 2014.

Project proposed seven tasks to accomplish. Some of these tasks were shared with a grant funded by State of Alaska's Alaska Energy Authority. NVPG hired a contractor, Richmond Engineering, for technical work such as heating system design and utilized in-kind assistance from Chugachmiut to complete the project.

Project Goals and Objectives

1. Develop Renewable Energy Resource Supply
2. Finalize Preliminary Heating System Design
3. Finalize Preliminary Project Costs
4. Acquire Revenue Stream Agreements and Develop Financial Management Plan
5. Acquire Site Agreements
6. Acquire Permits
7. Develop Business and Operating Plan

5. Project Activities

Summarize project activities for the entire period of funding, including original hypotheses, approaches used, problems encountered and departure from planned methodology, and an assessment of their impact on the project results. Include, if applicable, facts, figures, analyses, and assumptions used during the life of the project to support the conclusions.

NVPG began the *Port Graham Biomass Community Heat Demo Project* as the next step following the DOE Tribal Energy Program feasibility study begun in 2006 and completed in 2007[3]. The feasibility study made the recommendation that it was feasible to install a biomass technology for heat production in the community. An accompanying project, the *Building Tribal Energy Development Capacity for the Port Graham Biomass Project*, was completed October 2009 that was funded by U. S. Department of Interior's Office of Indian Energy and Economic Development preparing the Village Council to have the capacity and capability to run and operate a biomass utility business. These efforts were initiated following the development of a two phase *Integrated Resources Management Plan for Nanwalek and Port Graham, Alaska* supported by BIA that occurred between 2006-2009 that included a renewable energy plan to utilize biomass technology for community heating purposes.

[3] *The Potential for Biomass District Energy Production in Chugachmiut Communities*, Energy & Environmental Research Center, July 2007.

Two grant awards were applied for by NVPG to complete preconstruction activities. One proposal was sent to the State of Alaska's Alaska Energy Authority for Round 4 funding and one proposal to the Department of Energy Tribal Energy Program. Both grants were written in the fall of 2010. Notification of awards came at different times essentially to accomplish the same project.

Receipt of similar grant awards created a conflict regarding how to utilize them. NVPG did not wish to give up either award and elected to ask AEA and DOE whether they could bring the two grants together in a complementary manner to accomplish all the proposed preconstruction activities. Both agencies were contacted and assessed of the situation with a request to compatibly use both funding opportunities. These requests were granted sequentially by AEA in September 2012 and DOE in February 2013.

See Table 1. *Grant Award Dates and Amendment Dates* shown below.

Table 1. Grant Award Dates and Amendment Dates

AEA Grant Award Number 7040061

Original Award	August 1, 2011
Amendment #1	
Approved	January 10, 2013
Signed (PG)	January 25, 2013
Signed (AEA)	February 4, 2013

DOE Grant Award Number DE-EE005637

Initial Notification	February 22, 2012
Scope Revision Submitted:	May 8, 2012
Original Award	September 7, 2012

Selection of contractors were sought to help with each award. For DOE DE-EE005637 Award, solicitations were sent out over two weekends November 2012. Richmond Engineering, Inc. and Charles Nash Forestry Consulting Company were chosen from a pool of three qualified contractors. Richmond Engineering was selected as the biomass technology design firm that included drawings for a building design and a WHS 3200 GARN boiler installation to a heat loop that would connect to the five community buildings intended to utilize the biomass generated hot water system. Charles Nash Forestry Consulting Company joined Richmond Engineering as a subcontractor. Their work was to work on the economic estimation for fuel source supply that included both the source supply and delivery costs.

For the AEA Award, solicitations were sought in October 2012 and selected. Chena Power, Inc. was the selected contractor out of three qualified firms. Chena Power was asked to complete the environmental assessment and permitting needed for the site construction, update the economic and financial analysis, and complete a business and operational plan.

Intentions to begin the project were good. However, we ran into confusion on who would do what for the contract. NVPG was working with Chugachmiut to initiate the program yet the revised scope of work for the two awards joined caused confusion between the two program managers and the two contractors. A joint meeting was set up June 13, 2013, at the NVPG Office in Port Graham, Alaska to sit down and sort out the scope of work between the parties involved. Chena Power of the AEA Award by this time had included Winters and Associates Company as a subcontractor to them to help out with their part of the contract. During the course of the meeting as the work was being sorted out a table outlining the scope of work was developed by Nadine Winters that became the scope of work guide by which the various parties followed. See Table 2 *Native Village of Port Graham Biomass Demonstration Project AEA and DOE Task Lists*.

Table 2. ***Native Village of Port Graham Biomass Demonstration Project AEA and DOE Task Lists***

Port Graham Village Council	
Biomass Demonstration Project	
AEA and DOE Task Lists	
AEA	**DOE**
Environmental Review	Design
Identify environmental permits required	Construction Estimates
Action Plan for implementation	Construction site agreements, use of existing facilities
Operating budget estimates and model	Fuel source - estimates, budget model, agreements
	Rights of Way
Assistance provided to Port Graham Village Council by Contractors from both funding sources:	
Development of fuel supply agreement	
Identify options for facility and resource operations	
Support in contract negotiations	
Funding/financing options	

From Table 2, above, the DOE grant scope of work included engineering design, construction estimates, construction site agreements, use of existing facilities (the buildings to be heated by the hot water loop), fuel source harvest and delivery budget model and fuel source agreements along with rights-of-way agreements.

Similarly, the AEA grant scope of work became an environmental review, identification of permits required, an action plan to implement the biomass technology that would include an operating budget estimate and model.

Jointly the two contractors and Chugachmiut would provide assistance to NVPG to develop fuel supply agreement models, identify options for facility and resource operations, support in contract negotiations, and look at funding and financing options.

The seven goals and objectives were broken into seven tasks as identified in the DOE grant award document DE-EE0005637[4]. A summary of what was accomplished and challenges involved for the DOE grant and AEA grant are included as follows:

[4] *DOE Assistance Agreement DE-EE005637; Statement of Objectives*, June 1, 2012, Page 1-5.

Task 1 – Develop Renewable Energy Resource Supply

a. Develop sample fuel supply agreements and assess necessary contractual terms to develop a sustained fuel supply for the proposed facility.

The community building biomass heat technology would require 125-tons bone dry wood per year (100 cords). Estimated life of the project is between 20 and 25 years. A typical acre of timberland in the Port Graham area will provide a biomass resource of 88 bone dry tons per acre of mature Sitka Spruce[5]. From this estimate, it was inferred a harvest of two-acres of timberland would be required per year to meet the 125-tons bone dry wood per year needed. For the life of the project, the amount of timber lands needed would approximate 40-50 acres, more or less.

PGVC has signed a letter, *Letter of Intent to Reach an Agreement of Sale of Woody Biomass Material Between Entities Described*, April 30, 2015. This letter comes at the close of the time of this report and is welcomed. It will be mailed and is listed in Appendix B, for reference. The remainder of this section describes the negotiating process and the development of different types of agreement that could be used for a fuel source agreement.

Early negotiations with PGVC met with a reluctance to enter into a contract without being supplied with more information about a biomass fuel source agreement. PGVC had logged its timber lands late 1980s to early 1990s. Port Graham community members and PGVC board members have since then had a reluctance to cut any more trees. Therefore, entering into a fuel source agreement using woody biomass would take a deeper look into what that type of agreement would entail.

There were three fuel supply agreements developed for Port Graham Corporation to review. The first agreement was adopted from a commercial scale biomass fuel source agreement. That agreement, in places, includes fairly technical requirements such as determining the quality of biomass obtained in a sale and related weight measurements. See Task 1 Subsection c for more in-depth discussion on some specific terms in a woody biomass fuel source agreement. The second agreement is a pared down version of the commercial scale agreement written along the lines of a resolution to describe a biomass fuel source agreement and somewhat like a letter of intent that could be used before entering into an agreement. The third agreement was a shortened version of an agreement to enter into a letter of intent that would lead to a fuel source agreement. The three fuel supply agreements can be found in Appendix B Bibliography/Mailed Attachments.

[5] *Port Graham Biomass Project*, Page 12.

Without having a biomass technology in place, PGVC had expressed a reluctance to sign any agreement. A fuel source agreement and a letter of intent leading to a fuel source agreement were not something PGVC wished to negotiate or enter at the time. Letters of Intent by definition is an agreement in good faith, with legal implications, where two parties agree to enter into negotiations for an agreement. We understand PGVC's reluctance to sign such agreements. The first two agreement examples were designed to demonstrate the full nature of biomass fuel source agreements and were presented as references. A simple timber sale contract was added just to demonstrate how a small scale timber sale could be written. These example agreements will be mailed and listed in Appendix B for reference.

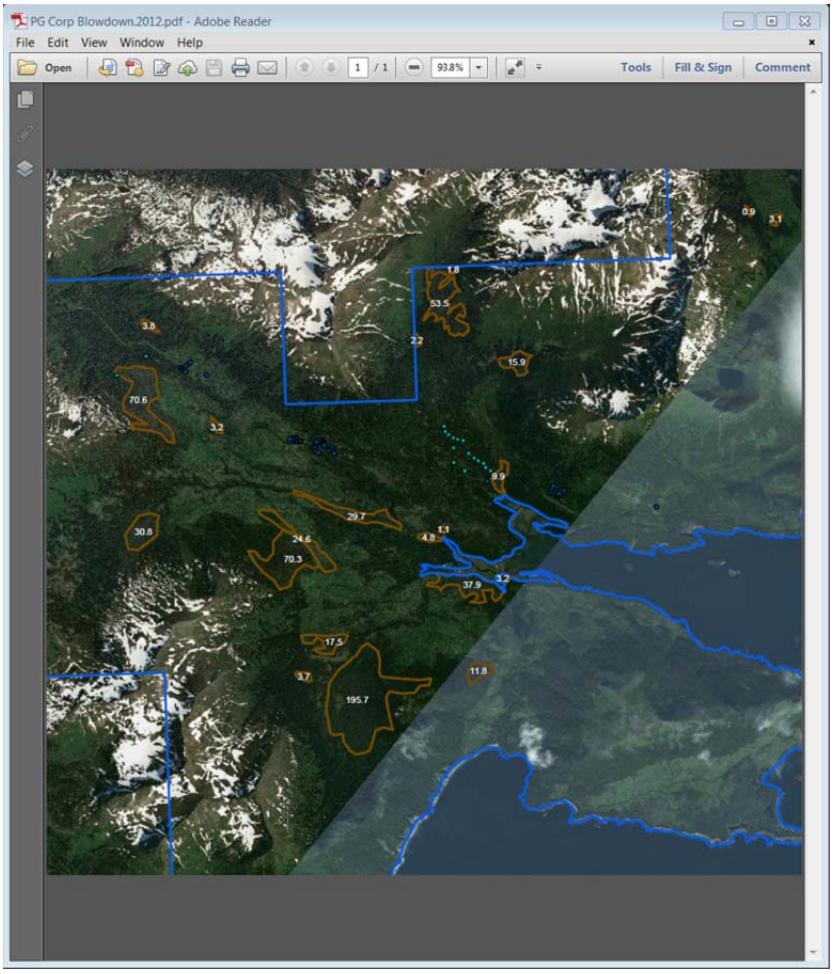

Figure 2 Port Graham Village Corporation Lands Wind Throw Tracts in Acres

In contrast to PGVC's early reluctance to enter into a fuel source agreement or even make a commitment to enter negotiations for such agreement, is the amount of wind thrown timber on PGVC's lands. Chugachmiut Forester found current accessible wind thrown resources on over 139 acres that is reported in the *Port Graham Biomass Project* report on Page 11. A more recent assessment of wind thrown timber on PGVC's lands is over 750 acres of land[6]. Furthermore, an upcoming airport project in the area will take 157 acres of mature

[6] *A Forest Stewardship Plan: for Port Graham Corporation Lands*, N. Lojewski, CF April 2015.

timberlands. See Figure 2 *Port Graham Village Corporation Lands in Acres.* From a fuel supply point of view, there is currently much more biomass available now than could be utilized for the intended biomass project and into the near future. For the later years of this particular biomass technology project, it is reasonable to assume there is enough supply to meet future demands.

Given the nature of PGVC's reluctance, much effort was taken by Chugachmiut to assess woody biomass fuel supply within reach Port Graham's road system. Chugachmiut Forestry conducted two forest inventory cruises on Port Graham Native allotment lands and PGVC lands. Summary of the field work was backed by aerial photography, satellite imagery, and LIDAR interpretation. Report of this study titled *Port Graham GARN Boiler Harvest Plan* is included in the AEA report *Port Graham Biomass Project*; both are attached in Appendix B Bibliography/Mailed Attachments. The second report that is more specific to PGVC land is included in the *A Forest Stewardship Plan: for Port Graham Corporation Lands* report is in draft form at time of this report.

Within the *Port Graham GARN Boiler Harvest Plan* is a description of locations of wind thrown timber accessible to the Port Graham road system on Page 3 of that report. There were 78 acres of wind thrown timber lands reported. One Native allotment land was identified showing 6-harvest size units suitable to supply woody biomass material for 6-years for the biomass project proposed. Recently, March 2015, the Native allotment landowner wrote a letter to Chugachmiut to initiate a sale of timber. Sale area described would match the harvest plan described in the same report first mentioned in this paragraph. The allotment owner's letter is attached in Appendix B Bibliography/Mailed Attachments.

b. Evaluate three fuel supply procurement alternatives. Ranking will be made according to ability, cost, and sustainability in relation to the operations of the biomass system. The three options include contracting with interested Native allotment owners, Port Graham Village Corporation and Native Village of Port Graham.

The AEA *Port Graham Biomass Project* report concluded that NVPG with its "administrative structure in place would hire a temporary three-man crew to harvest the necessary woody biomass for the project." The report also stated this crew could produce the required 100 cords in approximately 12.5 working days[7]. Work would be done by

[7] Page 22.

chain saw felling and bucking and skidding. Ideally, NVPG would obtain a logging skidder and use a logging trailer that could be towed using existing vehicles. Alternatively, any capital investment in more mechanized or newer biomass mechanical systems for such small volumes of woody biomass harvest were deemed unviable. Given the size of mature timber in the area, a log splitter would round out the need for equipment.

Alternatives to biomass procurement could be done by the local landowners. PGVC with its plentiful wind thrown biomass could hire its own employees to harvest woody biomass material. Area Native allotment owners could similarly harvest their own woody biomass material. NVPG could then purchase such fuel sources. A third party of individuals or groups could also sell biomass material to NVPG. For early biomass fuel stocks, it was determined to keep such supply fairly organized and obtained from known sources obtained under fuel source agreements.

The economics of woody biomass supply are discussed in the AEA *Port Graham Biomass Project* on Pages 14-26. From that study, a stumpage price or $17.50 per cord was determined based on a timber appraisal in Port Graham in 2012. Wind thrown timber in some parts of Alaska was documented selling at $1.00 per ton (1.25 tons per cord Sitka Spruce). The stumpage price is used in determining what to pay landowners. Purchasing woody biomass material other than what would be obtained from NVPG was not determined. Craigslist in Anchorage, Alaska lists cord wood anywhere from $75-$300 per cord. Range is due to whether the wood is split, dried, or which species, birch or spruce. AEA *Port Graham Biomass Project* report estimated delivered wood at $81.00[8] per cord.

Once biomass supply is delivered to NVPG, stoking of the biomass boiler could be done by one of the staff maintenance or janitor employees of NVPG. Generally, these positions are part-time and would allow additional hours of employment.

c. Review sample fuel supply agreements with Port Graham Village Corporation.

The first biomass fuel supply agreement mentioned in Task 1 Subsection a is *Energy Crop Biomass Fuel Supply Agreement Between Port Graham Village Corporation and Native Village of Port Graham,* December 2014 located in Appendix B. A PowerPoint presentation, PowerPoint presentation to PGVC *Notes to Energy Crop Biomass Fuels Supply*, January 2015, was made to PGVC January 2014 because of the complexity of the

[8] Page 16.

fuel supply agreement. Several of the terms of agreement to note in this summary are shown below. See the supply agreement in Appendix E and PowerPoint in Appendix B for more detail.

- Delivery Point—the place where biomass fuel supply is purchased. There is a historical log-storage yard just above Port Graham community that was used by PGVC when it logged its lands in 1980-1990s. Land is controlled by NVPG. NVPG would take control of the biomass fuel and deliver it to the boiler site.
- Term of Contract—5-year terms were suggested with 5-year extensions. Provides options to exit the fuel source agreement and options to extend the agreement for the life of the project.
- Quantity—is used to ensure a sufficient supply from the seller is available for the life of the project. Alternates include obtaining fuel supply from more than one supplier, if approved by both parties.
- Invoice, Billing, and Payment—need to detail how payments are made and leads to a discussion on the quality and quantity of biomass delivered for payment.
- Biomass Fuel Quality—both moisture content of wood and volume of wood per weight are determined. Moisture content is generally expressed as a percentage of moisture in addition to bone dry weight or percent moisture per weight of wood comes to two different estimates and must be determined. Green woody biomass has a variable amount of moisture content and would require different harvest volumes to achieve bone dry weight equivalents for determining sale.
- Biomass Fuel Quality—wind thrown trees may have less moisture content than live healthy trees but mad lose wood burning quality due to degeneration over time of wind thrown to harvest and point of sale to delivery point. A very complex determination of wood quality Btu capability is shown in the *Energy Crop Fuel Supply Agreement*. Bone dry Sitka Spruce contains approximately 18.1 million Btu per ton.
- Biomass Fuel Quantity—volume to weight is a function of moisture content and Btu quality. The *Energy Crop Fuel Supply Agreement* outlines conditions by which Buyer and Seller agree to determine such quality and delivery. For NVPG, Buyer, and PGVC, Seller, in this example, the more likely scenario would be to use a kind of crib structure that once filled with woody biomass material be used as a means of determining a volume of cord wood. In addition to moisture content and Btu quality, volume measurements used must factor in void space to determine equivalent weights that would equate to bone dry tons or bone dry cords that have an equivalency to bone dry tons.
- Inspection—one of the scenarios is to test the weights of certain volumes woody biomass material that can be determined by either party in either party's presence.

Generally such methods are employed at the beginning of a sale or a change of conditions of biomass wood.

d. Continue to refine and update resource assessments (growth rates, windfall, airport and road projects clearing, allotment owner interest, etc.).

Chugachmiut completed two initial forest inventory assessments during the course of the NVPG Community Biomass Project. The first assessment was included due to BIA required work on Native allotment lands in the creation of its *Forest Management Plan for Native Allotments in the Chugach Region of Alaska,* N. Lojewski, Charlie Sink, CF Chugachmiut Forestry Program Anchorage, Alaska September, 2012, in Appendix B. Specifically for the NVPG study, the *Port Graham Biomass Resources Assessment*, Nathan Lojewski, Chugachmiut Forestry, January, 2013, was completed but has not been signed or approved at time of this report.

The *A Forest Stewardship Plan: for Port Graham Corporation Lands*, N. Lojewski, CF April 2015 was recently completed for PGVC. Document provides a more current resource assessment of PGVC's lands. This includes the finding of additional wind throw material. Report is mentioned for reference but has not been signed or approved yet.

One addition to estimating forest volumes is the introduction of LIDAR. This laser reflected light imaging is a significant improvement at measuring tree heights over other systems. Coupled with ground based forest plot measurements, one can determine gross biomass measurements over large areas of forest lands that are accurate enough to use as generalized measurements. Chugachmiut's forester took forest plot measurements on Native allotment lands in one study and PGVC lands in another study where both field plot measurements were used to estimate woody biomass tons per acre over most of Port Graham area Native allotment and Native corporation, PGVC, lands. Of interest here, is the use of LIDAR requires fewer on the ground measurements to determine biomass volumes per acre. These measurements were then converted to toms per acre. Assessment incorporated a new measurement methodology to determine volumes.

State of Alaska Department of Transportation is nearing development of a new airport to be shared between Port Graham and Nanwalek, Alaska. In the AEA *Port Graham Biomass Project* report, approximately 157 acres of mature timber would be harvested for the project. Project construction is estimated to begin 2018 and to be

completed around 2020. Such project could more than supply NVPG biomass project for a period that the quality of wood taken could last.

Chugachmiut Forestry will continue into the future to monitor woody biomass and other resource supply forest material on Native allotment lands and Native corporation lands.

e. Continue to refine and update supply chain economics assessment (capital requirements for equipment, stumpage, labor, fuel cost maintenance, yard-operating costs, etc.).

- Chugachmiut Forestry serves Native allotment landowners within the Chugach Region of Alaska. As part of those duties, requests by landowners for timber sales are developed. Keeping up with forest measurements is part of the BIA described management planning on an ongoing basis.
- Chugachmiut Forestry provides technical assistance to regional Tribes and Native corporations upon request whether as a contribution or for fee. This technical assistance capability can help with keeping up on the changing and evolving costs to biomass fuel supply. These changing costs could include equipment costs and additions, stumpage estimating, labor costs, fuel costs, yarding and operating fuel extraction costs, transportation costs, and maintenance costs related to fuel source harvesting.
- NVPG would monitor and track their operational and maintenance costs for the community biomass heating technology.

f. Conduct meetings with native allotment owners that have the potential to provide fuel supply and describe the economic opportunity to sell timber, request input to forest management / stewardship plans, and review initial fuel supply letter of intent and draft contracts.

There were three community meetings held. The initial meeting with Native Village of Port Graham began with a scoping meeting regarding conjoining the AEA grant and DOE grant held April 11, 2013. The next meeting held at Native Village of Port Graham office was an open meeting to the Port Graham community members, NVPG, and its contractors. This meeting was held June 13, 2013, in Port Graham, Alaska. This second meeting was the major community meeting where the community was informed of the community biomass project and what the project would try to accomplish. Most of the community members present including council

members and employees were Native allotment owners and shareholders of PGVC, the Native corporation that retains a majority of accessible forest lands.

Meeting was also a face to face meeting between the two different contracting groups. NVPG's prime contractor for the DOE grant was represented by George and Steve Richmond of Richmond Engineering. Their subcontractor Charles Nash of Charles Nash Forestry Consulting was also present. For the AEA grant, Chena Power, Inc. owner Bernie Karl and Project Manager Jack Whitaker were present along with their subcontractor Nadine Winters of Winters and Associates Company.

The third meeting entailed a scheduled site visit August 6, 2013, by National Renewable Energy Labs' Chugachmiut START Program Manager Colton Heaps and Engineer Chris Gaul. However that meeting turned into a meeting with Chugachmiut at their Anchorage office that same day.

Chugachmiut Realty and Forestry contacted Native allotment AKAA 007196 landowner regarding wind thrown timber located on landowner's Native allotment. Forestry advised the landowner regarding forest management allotment. The landowner sent a letter dated March 30, 2015, to Chugachmiut Forestry asking Chugachmiut to help set up a timber sale on the allotment referencing a Silviculture prescription be developed. This letter initiates the first fuel supply contract that would be developed for the DOE project.

Chugachmiut Forestry had completed a BIA directed forest management plan in 2012[9], just before work on the DOE grant project began, and will be sent by mail to DOE and would be located in Appendix B of this document. Then, during the course of the project, Port Graham Corporation contracted with Chugachmiut Forestry to complete a Forest Stewardship[10] grant for management of their lands. A draft plan has been completed but not signed or approved at the time of this writing.

g. Develop fuel extraction plan based on landowner participation and resource economics.

See subsections a-c above.

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[9] *Forest Management Plan for Native Allotments in the Chugach Region of Alaska,* N. Lojewski, Charlie Sink, CF Chugachmiut Forestry Program Anchorage, Alaska September, 2012.

[10] *A Forest Stewardship Plan: for Port Graham Corporation Lands,* N. Lojewski, CF April 2015.

h. Negotiate fuel supply letter of intent with Port Graham Village Corporation and Native allotment owners.

See subsections 1-c above and Appendix B.

i. Finalize fuel supply agreements with Native Allotment owners and Port Graham Corporation.

Native allotment AKAA 007196 landowner made request for sale of timber on her lands to Chugachmiut's Forester March 2015.

PGVC has stated they do not wish to sign any agreement until the community heat project is built.

Task 2 – Finalize Preliminary Heating System Design

a. Finalize Detailed GARN Boiler and Hot GARN Boiler and Hot Water Distribution System Engineering and Preliminary Design.

Richmond Engineering, Inc. was the contractor that begun early and the contractor that was the most interactive with NVPG. Richmond signed a contract with NVPG May 20, 2013. Richmond then traveled to Port Graham Tribal Council Office for the initial community meeting and scope of work meeting with the Tribal council and the other contractors June 13, 2013. The first set of drawings made by Richmond was submitted to NVPG August 1, 2013. At the time, Richmond noted the GARN Boiler manufacturer had upgraded their largest boiler and would necessitate enlarging the pump building design.

Due to the enlargement of the building design for the biomass boiler upgrade, Richmond Engineering gave NVPG notice that the general building construction modifications were part of their original fee proposal and scope of work. Original scope of work was for using the Old Water Plant building's concrete foundation as the building dimension design basis. The previous large GARN Boiler would have fit this foundation. After the increase in boiler size, the building design needed to be changed accordingly. Richmond offered to meet with the Tribal council regarding such change noted in an email dated October 15, 2013.

During this period, a DOE Office of Indian Energy Strategic Technical Assistance Response Team (START) Program grant was given to Chugachmiut to help with its assistance to NVPG for the DOE Community Biomass Heat Project May 20, 2013.

Not much work toward the project was completed at the time and a waiting time occurred until Richmond Engineer began providing engineering drawings.

After the first set of Richmond Engineering drawings were submitted, a series of reviews were begun by NREL technical advisors. The first of NREL's comments on Richmond Engineering's designs began August 28, 2013, followed by Richmond's responding to or adapting NREL's suggestions. NREL's comments on Richmond's designs continued November 1, 2013 and followed by Richmond's comments December 10, 2013. NREL's Program Manager Colton Heaps, Engineer Chris Gaul, Alaska Senior Project Leader Brian Hirsch, and Levi Kilcher became involved.

Richmond Engineering completed their revised design set of drawings January 10, 2014, followed by their submittals January 21, 2014, for their Construction Specifications and Cost Estimates

Port Graham Community Building's included in the DOE Project design were site inspected by NREL's Colton Heaps and Levi Kilcher February 28, 2014. The two conducted heat loss testing over the next two-days.

NREL's Brian Hirsch enrolled Chugachmiut's Charles Sink into the *Biomass Heating Integration Workshop* sponsored by Alaska Energy Authority and U. S. D. A. Forest Service that was taught by John Siegenthaler, P.E. in Anchorage March 3-4, 2014. Later, NREL's Colton Heaps asked Mr. Siegenthaler to review Richmond's engineering drawings March 21, 2014, by conference phone. Purpose for the workshop enrollment and review by Mr. Siegenthaler was to improve Richmond's engineering designs. Colton's notes of the events are in *NREL Emails*, found in Appendix B.

Richmond Engineering incorporated a number of the review items by NREL's Chris Gaul and from the notes taken by Colton Heaps regarding John Siegenthaler's suggestions. Refinement continued over summer of 2014.

The new building revised scope of work for engineering design was modified November 10, 2014. Richmond informed NVPG that completed design would be delayed for 90-days due to other commitments. Due to the delay, NVPG requested a 90-day extension of time to allow for the delay. Extension was granted by DOE December 19, 2014.

Final drawings were submitted to NVPG March 13, 2015, by Richmond Engineering. NVPG Chief Patrick Norman's review of the drawings requested a change from a 4-sloped roof to a 2-solped roof. Richmond agreed and sent final design March 31,

2015. Final drawings, specifications, and cost estimates are mailed and listed in Appendix B for reference.

Task 3 – Finalize Preliminary Project Costs

a. Estimated Engineering Costs.

Richmond Engineering first sent a set of construction estimates to build the project November 4, 2013. Construction costs were estimated $210,634.00 with Old Boiler Building expansion renovation cost estimated $18.467.56. Total estimated cost was $219,101.56.

b. Final Preliminary Engineering Costs.

Due to modifications, construction costs needed to be updated. During the period of the NREL START team review of Richmond Engineering's drawings caused the need to update the construction costs. The next update occurred. October 1, 2014, revised the construction cost estimate to $251,693.00 with a Boiler Building expansion cost estimated at $18,467.56 and had a total estimated cost $270,160.56.

The final cost amount for the Boiler Building was submitted March 31, 2015, due to the new building design required of the larger boiler. Since a new building is required, costs for the project have increased significantly. The construction estimate remained the same at $251,693.00. However the new building design increased significantly to $97,828.40 and has a total estimated cost $349,521.87.

c. Refine Project Economic Model (capital, operating, financing terms, etc.) to determine financing and grant requirements.

To refine project economic model is to utilize the Economic Modeling spreadsheet in the AEA *Port Graham Biomass Project* report by Chena Power, Inc. Appendix B. That table is on Page 32-34 of that report. Using an active version of the spreadsheet, input data can be updated. Chena Power based capital costs on the first estimated engineering costs. In that simulation the benefit to cost ratio was estimated to be 1.16, which is feasible from an investment point of view, although by a small margin.

Using the active version of the spreadsheet using input data from Richmond Engineer's last estimates October 1, 2014, the benefit to cost ratio is estimated to be 0.97. A benefit to cost ratio less than 1.0 is considered not a good investment. Such an investment would benefit from a construction grant to better help economics of the project.

The final estimate March 31, 2015, brings the project to a benefit cost ratio of 0.70.

d. Financing and Funding — Refine and update evaluation of available project funding mechanisms, public and private incentives and funding sources for project implementation.

A Stage 2 Alaska Energy Authority Renewable Energy Fund Round VIII grant was applied for October 22, 2014, for the construction phase funding for the Port Graham Building Biomass Heat Distribution Project. AEA added in the AEA project funding for the *Port Graham Biomass Project* at $75,000.00 plus adding in the DOE project funding for the *Port Graham Community Building Biomass Heat Project* at $127,640 to estimate overall project costs. By AEA's estimate the benefit to cost ratio of 0.36 was estimated. AEA notified NVPG December 4, 2014, project was one they did not wish to invest.

State of Alaska is going through a funding crisis in 2015. The projected crisis will likely go through 2016 and perhaps into 2017. Therefore, funding through Alaska Energy Authority's programs may be very limited.

Fortunately, federal funding programs are available. U. S. Department of Agriculture Rural Development has several programs that could help fund the project as biomass renewable energy systems qualify for funding under certain programs. Examples include *Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Loans & Grants,*[11] *Community Facilities Direct Loan & Grant Program in* Alaska[12] and other related programs. Under the named program, renewable energy grants can be obtained up to $500 thousand while loans under $5 million can be obtained with 20% down payment from borrower and sufficient collateral. Each funding program has variations in how to qualify and anyone looking to use USDA funds is recommended to contact their local office. Alaska's local office is located in Palmer, Alaska at 907.761.7707.

U. S. Department of Energy has a number of funding programs for renewable energy projects. Financing opportunities can be found under U. S. Department of Energy Energy Efficiency & Renewable Energy Tribal Energy Program under Funding

[11] http://www.rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency
[12] http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program/ak

opportunities[13]. DOE has its own funding and financing links[14] including those for clean energy project development.

U. S. Small Business Administration has small business loan programs. Their basic loan program is the 7(a) Loan Program[15] to eligible borrowers for starting, acquiring, and expanding a small business. If NVPG were to use a third party vendor to commercially install the biomass heat plant and were to operate the project, this type of loan would be suitable. These loans are generally longer term financing based on ability to repay, purpose of the loan proceeds, and useful life of assets financed. For equipment, the loan period matures at 10-years.

U. S. Bureau of Indian Affairs has a Loan Guaranty, Insurance, and Interest Subsidy Program.[16] BIA provides these guarantees after application through commercial banks for up to 90% of the loan balance. Borrower must plan to have at least 20% equity in the project being financed.

One other financing mechanism is to find private investors. The project is likely too small for venture capital investors. However, the intended project may be appealing to an investor that would be willing to finance the project despite the apparent risks. Such investor would likely assume that fuel oil prices may rise significantly over the life of the project that making an investment at lower oil prices would not dissuade them. Finding such investors would take research.

e. Determine optimal financing package elements.

Determining an optimal financing package has not been accomplished. Construction funding is currently being sought through agencies that supply grant funding for renewable energy projects. Agencies that supply grant funding to Tribal organizations are specifically sought. Given changing cost increases for the project, financing scenarios likely would need a certain amount of grant funding if not full construction grant funding to make this project viable. A partial grant coupled with a lower interest loan over a longer term financing period could also make sense where 20 percent or more equity funding could be obtained from granting sources. Otherwise, if NVPG still supports the project, they may wish to provide the 20 percent equity financing needed to secure agency supported low-interest loan funding.

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[13] http://apps1.eere.energy.gov/tribalenergy/financial_opportunities.cfm
[14] http://energy.gov/public-services/funding-financing
[15] https://www.sba.gov/content/sba-loans
[16] http://www.bia.gov/WhoWeAre/AS-IA/IEED/LoanProgram/index.htm

f. Negotiate letter of intent with providers of financing package elements.

Letters of intent with providers that could provide financing for this project was not done as NVPG will attempt to find grant funding sources for the project, if possible.

g. Negotiate binding financing agreements (if possible).

Financing options have not been attempted at this point. Therefore, negotiations for binding financing agreements are not applicable.

Task 4 – Acquire Revenue Stream Agreements and Develop Financial Management Plan

a. Hot Water Sales — For heat distribution to community buildings, develop the necessary language and terms needed for sales agreement. Negotiate agreements for the sale and delivery of hot water energy from the GARN Boiler.

Hot water sales determination was addressed in the AEA report Port Graham Biomass Project under Section 14 *Financial and Other Responsibilities* on Page 26. One method to calculate how to share the costs between the five community buildings designed to be included in the hot water heat loop is to base a percentage of use based on gallons of diesel used historically per year. The example given is to aggregate the amount of diesel fuel used by each building into one amount and use that number to divide into each building use amount to estimate each buildings percent of use. A similar method was used based on percent of Demand Btu Hours per heating area square feet per building. See the report for further detail.

b. Monetize Renewable Energy Credits — Our task is to optimize the value of the renewable energy credits associated with GARN Boiler operations.

State of Alaska has a grant funding program through its Alaska Energy Authority office but not renewable energy credits. Federal energy tax credits are available for residential and commercial buildings for various renewable energy systems but not necessarily biomass systems[17].

[17] http://www.dasolar.com/energytaxcredit-rebates-grants/alaska; http://greenbuildingwire.com/alaska-renewable-energy-incentives

c. Complete Financial Management Plan – Incorporate renewable energy credits, available grant funding, low interest loan options, and other financial support to develop project. Plan will include operation, maintenance, and replacement financial plan.

Project economics were addressed in the AEA report *Port Graham Biomass Project* by Chena Power, Inc. Discussion of project economics begins on Page 14 under Section 8 *Project Economics*. The project economics discussion is based on an economic modelling table found in Section 16 on Pages 32-34 of that report, report is mailed and referenced in Appendix B. Model addresses financing, loan payment costs, operation and maintenance costs, and a replacement financial plan.

In this final report, in Section 5 *Project Activities Task 3 Subsections a and b,* reference changes in the final cost estimates. The AEA report *Port Graham Biomass Project* is based on initial project cost estimates of $210,634.00 while final costs estimates come to an estimated $349,521.87. Such increase in costs has already affected ability to fund project based on AEA's rejection of NVPG's proposal to them for project funding that was declined.

Task 5 – Acquire Site Agreements

d. Secure the development site by finalizing the Native Village of Port Graham's approval, as the site owner with fee simple title. This includes finalizing site and right-of-way surveys, title work, archeological and endangered species reviews and executing lease agreements.

Port Graham's Old Pump House building site is the designated property made available by NVPG for the project. Native Village of Port Graham is the governing body for the community of Port Graham, Alaska controlling its lands and operations and maintenance. NVPG also controls the land where the biomass heat loop is designed to be placed. Either project locations, heat loop or biomass building site, have not been separated from NVPG's other property for purposes of development. If a third-party were to take over the project and desired site control, a simple *Non-Binding Letter of Intent to Lease* was developed as a sample to use for that purpose and it can be reviewed in Appendix B. Such site separation would also require a legal description based on a survey for lands to be leased for such a project.

Task 6 – Acquire Permits

a. Develop budget and action plans for permitting. Include environmental and regulatory analysis of proposed plant construction and operations; fuel source harvesting permit requirements; specify emissions and waste disposal characteristics of plant; and harvesting activities to identify permitting information requirements.

The AEA *Port Graham Biomass Project* report addresses permitting in Section 13 *Permits Required*. The Kenai Peninsula Borough has no required permits. State of Alaska, Department of Public Safety, Division of Fire and Life Safety has a safety plan review for fire and life safety requirements application titled *Fire and Life Safety Plan Review.*

GARN Boiler from Dectra Corporation has a table of emissions for its two small boiler models shown in Table XXVX. These are tested emissions by a third party[18]. The new GARN Boiler WHS 3200 has yet to be tested by a third party was not available. EPA's requirements for hydronic heaters[19] effective in 2015 is set in two steps. Step 1 requirements of 18 grams per hour particulate matter for burner units sold until December 31, 2015. In Step 2 effective 2020, hydronic heaters need to meet or 0.15 pounds per million Btu (lbs/mmbtu). Both GARN's smaller boilers meet EPA's Step 2 requirements and GARN estimates the WHS 3200 boiler would also meet Step 2 requirements.

Table 3. GARN Boiler Particulate Matter Emissions Output and Rate

	GARN® WHS 1500	GARN® WHS 2000
Efficiency*	80.0%	88.4%
Emissions Output	0.131 lbs/mmbtu	0.088 lbs/mmbtu
Emissions Rate	2.87 grams/hr	1.65 grams/hr
Official Report	Click Here	Click Here

Cord wood utilization would leave a certain amount of ash that is mostly potash[20] would need to be cleaned out of the GARN 3200 boiler. Ash could be made to

[18] http://www.garn.com/emmissions/
[19] http://www2.epa.gov/residential-wood-heaters/fact-sheet-summary-requirements-wood-fired-hydronic-heaters
[20] http://www.thegreenhome.co.uk/heating-renewables/biomass/how-do-i-dispose-of-biomass-boiler-ash/

gardeners, composters, or simply spread back out into the forest. Recommendation would be to clean the ash from the boiler after 1 to 1.5 cords are used.

Certain amounts of boiler water treatment chemicals and additives are used to reduce scaling from corrosion and lime scale formation. Quantities that would be used in this system, these chemicals are not subject to SARA Title III 313 (40CFR372) reporting requirements. A sample material safety data sheet for hydronic system cleaner is mailed and referenced in Appendix B.

For biomass harvesting activities, fuel source extraction, the State of Alaska only requires following the Alaska Forest Practices Act for timber sale contracts. Native allotment lands are subject to BIA timber sale practices where a NEPA process is conducted.

b. Refine environmental permitting and regulatory compliance plan for the proposed plant and harvesting activities.

See subsection a. above.

c. Finalize emissions, effluents, and solid waste estimates as basis for permit scoping.

See subsection a. above.

d. Submit applications for required permits.

The application for the Fire and Life Safety Plan required by the State of Alaska would apply during the construction phase of the proposed biomass hot water boiler building.

e. Final environmental studies.

The two sites located on NVPG lands do not have environmental study requirements.

Fuel source agreement harvest plans would need to follow the Alaska Forest Practices Act on private lands. The Forest Practices Act requires a detailed plan of operations for harvests of 10-acres or larger. Annual harvest size needed for Port Graham's project is estimated around 2-acres per year.

U. S. Bureau of Indian Affairs timber sale procedures would be followed if sale of biomass fuel stock would be obtained from a Native allotment and not the Alaska Forest Practices Act as Native allotment lands are considered federal lands. A NEPA process would need to be followed on Native allotment lands. Most fuelwood harvesting that would take place for the Garn boiler project in Port Graham on a

Native allotment likely will fall under a NEPA categorical exclusion. The regulations are described in the *Indian Forest Management Handbook 53 IAM 4-H Permit Sales of Forest Products*, Pages 16-17[21].

Task 7 – Develop Business and Operating Plan

a. Develop a plan to document that will provide a compilation for how the biomass heating system will be managed and operated within the context of the Native Village of Port Graham, as owners for the benefit of the community. Information will include:

i. Management, ownership and legal structure of biomass heating system, and how it aligns with the Village's vision and community goals;

The AEA report *Port Graham Biomass Project* described how Port Graham Village Council would be responsible for the day-to-day operations and long-term maintenance of the biomass boiler in Section 14 *Financial and Other Responsibilities*, Page 26.

NVPG's capability to manage and operate renewable energy systems for their community was recognized by U. S. Department of Energy Office of Indian Energy and Economic Development under a TERA agreement in 2009.[22]

Quoting the energy policy for NVPG from their IRMP Phase II[23] study sponsored by the BIA, "It is the Energy Policy of Port Graham and Nanwalek to find and implement innovative options to reduce energy costs, to reduce fossil fuel emissions, to improve

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• [21] The handbook specifically lists a number of categorical exclusions here are two that would apply to a fuel wood sale on a Native allotment near Port Graham:

(2). Approval and issuance of cutting permits for forest products not to exceed $5,000 in value.

(3). Approval and issuance of paid timber cutting permits or contracts for products valued at less than $25,000 when in compliance with policies and guidelines established by a current management plan addressed in earlier NEPA analysis.

[22] *Building Tribal Energy Development Capacity for Port Graham Village Council*, U. S. Department of Interior Office of Indian Energy and Economic Development Tribal Energy Resource Agreement (TERA) by Port Graham Village Council and Chugachmiut, Margaret King and Associates, October 2009.

[23] *Chugachmiut Facilitated Integrated Resources Management Plan Phase 2 for Nanwalek and Port Graham*, Resource Solutions, March 2009, Page 19.

quality of power, and to provide greater opportunity for jobs that will attract members back to our communities."

ii. Financial considerations including tax considerations, projected revenues and revenue sources, financial performance benchmarks, customers, billing and collection procedures;

Tax considerations as non-profit utility by Kenai Peninsula Borough may be exempted. The borough could develop a Utility Special Assessment District if private property owners would be benefited. This project is mostly a community benefit and may not be subject to Borough taxation although the one property, PGVC's office building would benefit. The Borough developed a guide that addresses the subject called *A Layman's Guide for Establishing a Utility Special Assessment District (USAD[24])* and if the project were built, contacting the Borough to determine whether a special assessment would need to occur would need to be determined.

Project revenues are estimated $24,993, as shown in the AEA report *Port Graham Biomass Project*, page 17.

Customer billing would be assessed by PGVC on a percentage of hot water usage determined from previously estimated fuel oil consumption usage among the builders to be served.

iii. Description of the product/services; and

Total community building biomass system demands is 648,000 Btu's per hour, page 26. Estimate for total biomass heat cost is $24,993, page 17, a reduction from 2013 annual costs of $40,105 for an annual savings of $15,112.

iv. Operating procedures and jobs/positions required.

Operating procedures were not developed.

A job and position description was added to the AEA report *Port Graham Biomass Project* under *Miscellaneous Documents* Job Description, Page 48, see Appendix B. Basically, feeding the biomass boiler, cleaning the ash content out, and general maintenance of the system were the duties added.

Administrative duties managing the biomass operations would be absorbed by existing NVPG management and accounting duties.

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[24] http://www.borough.kenai.ak.us/assessing-dept/a-layman-s-guide-for-establishing-a-utility-special-assessment-district-usad

6. Concluding Remarks

Native Village of Port Graham desires to implement a Community Biomass Heating project. Over the course of the various studies leading to project development, heating five community buildings with biomass heated hot water heat-loop system may not be cost effective during periods of low fuel oil prices. Community heating on a larger scale may be more cost effective yet is also dependent on fuel oil pricing. Port Graham remains interested in supplanting fuel oil heating with local biomass heat production that could create additional jobs and utilize local landowner's resources. Investing in such a renewable energy project as this intended project would keep investment in energy production within the community and is a major consideration of NVPG.

While the benefit to cost ratio makes the project unattractive to conventional funding at this time, there could be an opportunity to seek a combination of funding to build the project. Combined financing could include a mixture of grant funding to the extent that it would improve the benefit to cost ratio that would make partial financing a viable option.

There has been a prolonged effort by NVPG to develop a renewable energy technology. NVPG has worked its way through several successive planning processes following phase development outlines provided by the U. S. Department of Energy Tribal Energy Program and others. NVPG feels they are ready for development and are disappointed this particular project in the end of all the planning effort is not as attractive as once thought. NVPG will remain poised to implement a renewable energy project that is reasonable and may need to go back to the "drawing board" to find a better solution for their energy needs.

Appendix A Chronology of Events over the Course of the Project

- Award
    - DoE Award September 10, 2012 – Grant Award Notice
    - AEA Award July 1, 2011 to December 31, 2012.
    - AEA Modification July 1, 2011 to December 31, 2013 was approved February 4, 2013.
    - AEA award—three responsive and reasonable proposals October 2, 2012 met with NVPG to review and score the three proposals and selected Chena Power as a contractor.
    - DOE award—Native Village of Port Graham solicited proposals to qualified firms for engineering designs services November 11 and 18, 2012. Three proposals were received and deemed responsive. A scoring criterion was developed and a firm was selected February 1, 2013, in Port Graham, Alaska. Project Principal Investigator Charles Sink facilitated. Richmond Engineering, Inc. was the selected successful contractor. Contract included fuel source extraction cost estimating work to be done by Charles Forestry Consulting as a subcontractor to Richmond Engineering.
    - An initial scoping meeting with Native Village of Port Graham and Principal Investigator Charles Sink occurred April 11, 2013, in Port Graham, Alaska.
    - ChenaPower, Inc. subcontracted to Nadine Winters May 2013 to draft up their portion of the work.
    - DOE Office of Indian Energy Strategic Technical Assistance Response Team (START) Program award to Chugachmiut May 20, 2013. A non-disclosure agreement between DOE and National Renewable Energy Laboratory (NREL) was signed May 31, 2013. NREL assigned Project Manager Colton Heaps and Engineer Chris Gaul to assist Chugachmiut with providing technical assistance.
    - Finalizing the scope of work occurred during a meeting held in Port Graham Tribal Council Office Port Graham, Alaska June 13-14, 2013. The meeting included Port Graham Tribal Council and their two respective contractors for the AEA grant and the DOE Grant and the contractors' two respective subcontractors. AEA grant contractor Chena Power included owner Bernie Karl, Project Manager Jim Whitaker, and subcontractor Nadine Winters Consulting. DOE grant contractor Richmond Engineering included George and Steve Richmond and their subcontractor Nadine Winters Consulting. Work divided up between AEA contract and DOE contract is shown in Table 1 *Native Village of Port Graham Biomass Demonstration Project AEA and DOE Task Lists*.

Port Graham Village Council	
Biomass Demonstration Project	
AEA and DOE Task Lists	
AEA	**DOE**
Environmental Review	Design
Identify environmental permits required	Construction Estimates
Action Plan for implementation	Construction site agreements, use of existing facilities
Operating budget estimates and model	Fuel source - estimates, budget model, agreements
	Rights of Way
Assistance provided to Port Graham Village Council by Contractors from both funding sources:	
Development of fuel supply agreement	
Identify options for facility and resource operations	
Support in contract negotiations	
Funding/financing options	

- Richmond Engineering submitted preliminary drawings week of July 1, 2013.
- Shortly afterwards, Richmond Engineering notified NVPG and Chugachmiut that GARN, Inc. had redesigned their large boiler, the WHS 3200 GARN Boiler Model. The new boiler design went from a 400 thousand Btu unit to a 700 thousand Btu unit. The new boiler design necessitated a building redesign for the project. Such a design change would add cost to the engineering design.
- Charles Nash Consulting required some renegotiation to occur between that firm and Richmond. Charles Nash Consulting was still experiencing delays in completing its portion of the Richmond contract. This delay also begun to affect the report being prepared by Chena Power and Nadine Winters Consulting.
- Richmond Engineering sent updated drawings to NVPG Chief Patrick Norman and Charles Sink October 15, 2013. Construction estimates and specifications were sent November 4, 2013.
- Chugachmiut Forester Nathan Lojewski conducted forest inventory work that included a biomass assessment of Port Graham area Native Allotments and Port Graham Village Corporation timberlands October 2013.
- Principal Investigator Charles Sink and Chugachmiut Forester Nathan Lojewski attended U. S. Department of Energy Tribal Energy Workshop October 21-23, 2013, in Fairbanks, Alaska. They met with Chena Power, Inc.'s Project Manager Jim Whitaker and subcontractor Nadine Winters.
- Begun a U. S. Department of Energy START project. National Renewable Energy Labs (NREL) was assigned the technical assistance service to Chugachmiut to help with the DOE Port Graham Community Biomass Heat Project. NREL assigned Program Manager Colton Heaps and Engineer Chris Gaul to the project. Both made some initial design suggestions to Richmond Engineering October 31, 2013.
- Ms. Winters and Mr. Sink traveled to Port Graham, Alaska November 1, 2013, to meet with Native Village of Port Graham and tour the project

sites. Ms. Winters was assigned to work on the environmental review and business operating plan by Chena Power.

- Richmond Engineering met on a phone conference with the NREL managers December 11, 2013 along with Port Graham Chief Patrick Norman and Principal Investigator Charles Sink, also recommending changes. Prior to that phone conference, Richmond Engineering's George and Steve Richmond met with Chief Norman and Mr. Sink during the Bureau of Indian Affair's Providers Conference in Anchorage December 5, 2013 to go over NREL's engineering design concepts.
- An arrangement was reached between Richmond Engineering's subcontractor Charles Nash Consulting Forestry and Chena Power's subcontractor Nadine Winters Consulting to collaborate on work needed by Chena Power that would be used by Winters Consulting from Charles Nash Consulting's portion of work. They began to work together week of December 16-20, 2013.
- AEA Program Manager Helen Traylor made a recommendation on December 12, 2013, to extend the AEA contract due date due to delays and misunderstandings between the various entities. AEA approved a no additional funding 6-month extension to end of June 2014.
- Richmond Engineering completed their latest final set of drawings January 10, 2014. Afterwards, January 21, 2014, Richmond submitted their Construction Specifications and Cost Estimates.
- Winters Consulting was trying to get out a draft report by February 2014 but had not had much cooperation from Charles Nash Consulting.
- NREL's Colton Heaps and Chris Gaul visited Port Graham, Alaska March 1-2, 2014. They took measurements of the intended heat loop placement area, Port Graham Old Pump House Building, and recorded and measured the diesel fuel heat boilers in the community buildings intended for biomass heating. They conducted stress tests on the buildings to test for heating capacity and heat loss.
- Colton Heaps provided an opportunity for Principal Investigator Charles Sink to attend the *Biomass Heating Integration Workshop* held in Anchorage, Alaska March 3-4, 2014. Workshop was sponsored by AEA and taught by John Siegenthaler, P.E. a mechanical engineer and Professor Emeritus of Engineering Technology at Mohawk Valley Community College in Utica, New York. The coursed was designed to address biomass hydronic heating and was based on his textbook *Modern Hydronic Heating* published in 2011.
- NREL's Colton Heaps asked Mr. Siegenthaler to review Richmond Engineering's Port Graham Community Biomass Heating designs. A phone conference was held March 21, 2014, and Colton took notes.
- While attending the DOE Tribal Energy Program Review Golden, Colorado March 24-27, 2014, after giving a presentation about the Port Graham Community Biomass Heat Project, Mr. Heaps gave a tour of the NREL labs including NREL's biomass heat and power plant to Port

Graham Chief Patrick Norman and Port Graham Tribal Administrator Francis Norman. Mr. Heap and Mr. Gaul in a meeting space made a presentation of their findings from the Port Graham stress testing and Mr. Siegenthaler's suggested changes to Richmond Engineering's drawings.

- Richmond Engineering reported delays in deliverables from Charles Nash Consulting Forestry regarding biomass fuel source delivery and operations costing information. Delay was causing delays to AEA contract Chena Power's work. A meeting was held with Chena Power Project Manager Jim Whitaker regarding having Nadine Winters Consulting going ahead and conduct the needed portions of DoE Richmond Engineering's subcontract to Charles Nash Consulting Forestry for work needed to be done to complete Chena Power's report for the AEA contract.
- Chena Power delivered their final AEA report to NVPG and Charles Sink July 1, 2014 and subsequently to Alaska Energy Authority.
- Chugachmiut's Forester Nathan Lojewski assisted Nadine Winters Consulting providing possible biomass harvestable fuel source areas, volume estimates, and harvest planning document that was used in the AEA report.
- Fuel source agreements were negotiated from August 2014 through the winter 2014-2015.
- Richmond Engineering was contacted October 9, 2014 and October 17, 2014 regarding final updates on engineering drawings and asked them to replace Charles Nash Forestry Consulting with Nadine Winters Consulting.
- Nadine Winters Consulting took over from Charles Nash Consulting Forestry completing the fuel source estimates for costing extraction and delivery of fuel wood and the business model for Richmond Construction November 2014.
- Richmond Engineering, after some delay was contacted December 17, 2014, to finish their engineering drawing update specifically for the biomass heat plant building. Richmond expressed a delay due to scheduling pressure as they had thought their design was complete. Richmond said they needed another 60-days before delivering updated drawings.
- Native Village of Port Graham requested an extension on the DOE contract for 90-days and was granted by DOE Program Manager Lizana Pierce December 19, 2014.
- Richmond Engineering submitted their final drawings March 13, 2015.
- Native Village of Port Graham requested a change in the roof design and that change was finalized March 30, 2015.
- A Native allotment landowner from Port Graham, Alaska signed a letter of interest to sell her wind thrown timber from her Native allotment to Native Village of Port Graham. The allotment harvest plan is included in the AEA report and is a 5-year harvest plan.

- Port Graham Village Corporation who owns a majority of timber land in the area has yet to sign any agreement, letter of intent, or letter of interest to sell biomass fuel to Native Village of Port Graham. They expressed a reluctance to commit resources to a project that is not yet built.

Appendix B Bibliography / Mailed Attachments

Construction Design Documents

Chugachmiut Biomass Facility Drawings, October 2013, mailed.

Port Graham Constr Estimate, March 2015, mailed.

Specs Assembled, March 2015, mailed.

Alaska Energy Authority Planning Document

Port Graham Biomass Project, Chena Power and Winters & Associates, July 2012, mailed.

Port Graham Biomass Resources Assessment, Nathan Lojewski, Chugachmiut Forestry, January, 2013, attached to *Port Graham Biomass Project*, above.

Planning Documents Cited and Mailed

Chugachmiut Facilitated Integrated Resources Management Plan for Nanwalek and Port Graham, Phase 1, ASCG Incorporated, September 2006, referenced.

Chugachmiut Facilitated Integrated Resources Management Plan Phase 2 for Nanwalek and Port Graham, Resource Solutions, March 2009, referenced.

Building Tribal Energy Development Capacity for Port Graham Village Council, U. S. Department of Interior Office of Indian Energy and Economic Development Tribal Energy Resource Agreement (TERA) by Port Graham Village Council and Chugachmiut, Margaret King and Associates, October 2009, referenced.

Forest Management Plan for Native Allotments in the Chugach Region of Alaska, N. Lojewski, Charlie Sink, CF Chugachmiut Forestry Program Anchorage, Alaska September, 201, mailed.

A Forest Stewardship Plan: for Port Graham Corporation Lands, N. Lojewski, CF April 2015, in draft form and not available to the public until signed and approved.

Native Allotment Landowner Letter to sell blown down timber to Chugachmiut Forestry, March 30, 2015, copy of letter mailed.

MSDS Hydronic System Cleaner, mailed.

The Potential for Biomass District Energy Production in Chugachmiut Communities, Energy & Environmental Research Center, July 2007, referenced.

Port Graham Heating Design Comments Between NREL and Richmond Engineering, mailed.

Timber Sale Contracts

Energy Crop Biomass Fuel Supply Agreement Between Port Graham Village Corporation and Native Village of Port Graham, December 2014, mailed.

PowerPoint presentation to Port Graham Corporation *Notes to Energy Crop Biomass Fuels Supply*, January 2015, mailed.

A *Letter of Intent to Reach an Agreement of Sale of Woody Biomass Material Between Entities Described*, March, 2015, described by PDF file as *PGVC.Chugachmiut.LoI.4.30.15.pdf*, mailed.

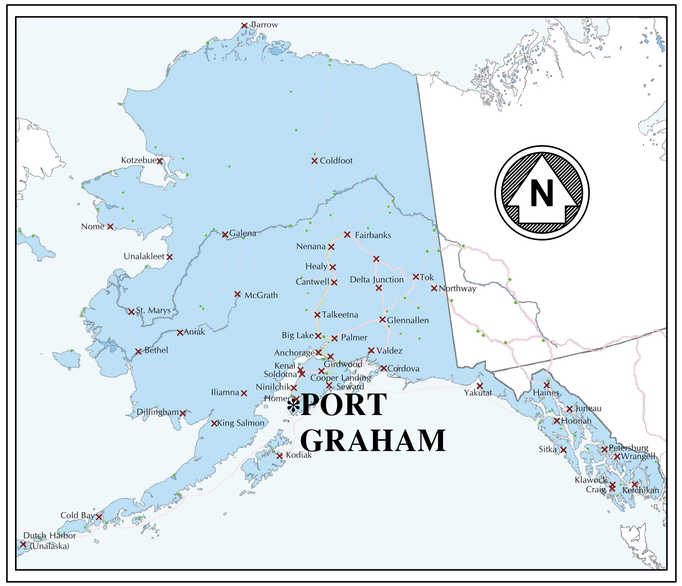
Sample Contract for Sale of Standing Timber Sample, February 2015, mailed.

CHUGACHMIUT BIOMASS FACILITY

OWNER

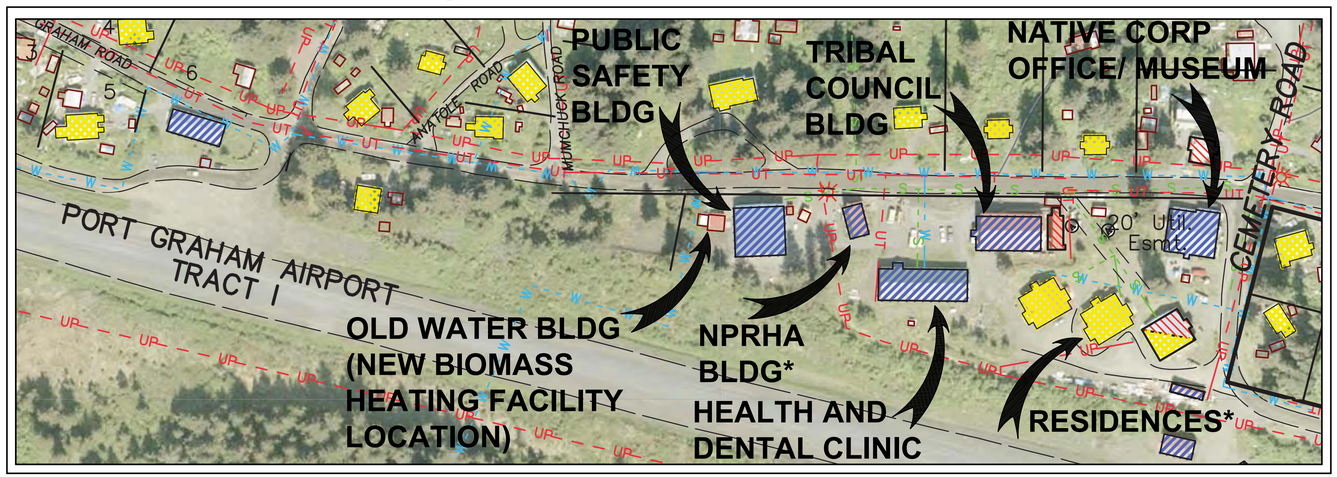
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663
OCTOBER 23, 2013

ALASKA STATE MAP



VICINITY MAP
PORT GRAHAM, ALASKA

*FUTURE BLDG CONNECTIONS



PROJECT TEAM

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BUILDING CODES

2009 ALASKA BUILDING ENERGY EFFICIENCY STANDARDS
2009 INTERNATIONAL BUILDING CODE WITH STATEWIDE AMENDMENTS
2009 INTERNATIONAL MECHANICAL CODE WITH STATEWIDE AMENDMENTS
2009 INTERNATIONAL FIRE CODE WITH STATEWIDE AMENDMENTS
2009 ALASKA ADMINISTRATIVE CODE TITLE 8 (PLUMBING AND ELECTRICAL)

INDEX OF DRAWINGS

CONSTRUCTION DOCUMENTS

DESIGNED: GMR
DRAWN: TMP
DATE: 10/23/13

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REVISION	CK'D	BY	DATE
REVIEW COMMENT REVISIONS	GMR	TMP	01/09/14
FINAL DOCUMENTS	GMR	TMP	03/09/15

SHEET CONTENTS: COVER SHEET
TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663
PROJECT NO.: 5222
SHEET:

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

GENERAL NOTES

These structural notes supplement the drawings. Any discrepancy found between the drawings, these notes, and the site conditions shall be reported to the Engineer, who shall correct the discrepancy in writing. Any work done by the Contractor after the discovery of the discrepancy shall be done at the Contractor's risk. The Contractor shall verify and coordinate the dimensions among all drawings prior to proceeding with any work or fabrication. The Contractor is responsible for all shoring and bracing during construction.

The structure has been designed to resist the specified lateral &/or vertical code required forces after the completion of construction. Stability of the structure prior to completion is the sole responsibility of the General Contractor. This responsibility includes but is not limited to: erection approach, methods and sequences, temporary shoring and bracing, formwork, and the use of equipment and construction procedures.

Construction observation by the structural engineer is for general conformance with the design intent only, is not a review of the contractor's construction procedures, nor is it to be considered 'inspection' as used in the construction industry.

All construction shall, at a minimum, conform to the applicable portions of the latest edition of the International Building Code and the Alaska Building & Energy Codes.

DESIGN CRITERIA:

Live Load	75 PSF snow 125 PSF occupancy load
Dead Load	15 PSF floor & roof 10 PSF walls 150 PCF concrete 35 PCF structural wood members
Wind	2012 IBC, Critical Facility 130 MPH, Exposure D wind
Seismic	2012 IBC Seismic Occupancy Category IV Design Category D
Soil	Assumed bearing pressure 2500 PSF on compacted gravel fill.

CARPENTRY:
Provide minimum nailing per IBC Table 2304.9.1 or more, as otherwise shown or noted. Provide cut washers where bolt heads, nuts, and lag screws head bear on wood. Do not notch or drill structural members, except as approved by the structural engineer. Where existing items are removed and replaced, replace in kind as to size, material, nail spacing, et cetera.

1. Pressure treated lumber shall be used in all locations required by the building code. Unless noted otherwise all pressure treated timber shall be #1 or better Hem-Fir material.

2. Lumber shall be #2 Doug Fir, Larch or better except as noted with a maximum moisture content of 19% at the time of installation.

3. Glue laminated beams shall be 24F-V8 for cantilevered or continuous beams and 24F-V4 for simple spans unless noted otherwise of the drawings.
   Fb = 2,400 psi
   Fv = 240 psi
   E = 1,800,000 psi
   FcL= 650 psi

4. Continuous and cantilevered glue laminated beams shall not be cambered. All other glue laminated beams shall be cambered for L/480. See the framing plans for any exceptions.

5. All plywood shall bear the trademark of the American Plywood Association. All panels shall be APA Performance rated panels. Plywood shall be nailed at 6" on center edges and 12" in the field unless noted otherwise on the drawings.

6. All nails shall be common nails unless noted otherwise. All nails shall be from American or Canadian Manufacturers only. Size and spacing at all sheathing edges shall be as per the shearwall schedule or as noted. Nail shank diameter of installed nails must be as specified.

Nail Size	Shank Diameter	Length
8d	.131"	2.5"
10d	.148"	3"
16d	.162"	3.5"

7. Versa Lam beams shall be supplied by Boise Cascade.

8. Trusses and truss bracing shall be designed by the manufacturer to resist the design loads noted above and the provisions of the Alaska Building Code.

HARDWARE:

All connection hardware shall be Simpson "Strong Tie" unless noted otherwise. Provide maximum size and quantity of nails or bolts per manufacturer, except as noted. Connection hardware exposed to the weather or soil shall be treated as in "STEEL" below. Fasteners shall be stainless steel where the connector is exposed to the weather or soil.

Pressure treated material requires that fasteners and connectors must be "post" hot-dip galvanized. Galvanizing shall be per ASTM A123 for connectors and ASTM A153 for fasteners. Simpson "Zmax" is an acceptable equal per ASTM A653.

Stainless steel fasteners and connectors are also acceptable for pressure treated wood.

When using stainless steel or hot-dipped galvanized connectors, the connectors and fasteners must be made of the same material.

CONCRETE & REINFORCING STEEL:

1. All concrete work shall be per the 2012 IBC Chapter 19. Tolerances shall be per ACI 318-08 Section 7.5. Mixing, placement, and inspection shall be per Sections 1903 (ACI Chapter 3), 1904 (ACI Chapter 4), 1905(ACI Chapter 5), 1906 (ACI Chapter 6), 1907(ACI Chapter 7) and 1704.9. See the drawings.

2. All reinforcing shall be ASTM A615 Grade 60 unless noted otherwise.

3. Splice lengths are based on class A splices in normal weight concrete. All reinforcing shall be lap spliced as follows:
   #6 and smaller 48x bar diameter
   #7 and larger 56x bar diameter
   No more than 50% of horizontal or vertical bars shall be spliced at one location.

4. Concrete shall be in accordance with ASTM C 150.
   F'c = 4000 psi @ 28 days
   slump = 4" maximum, 6% Air entrained

5. Concrete cover on reinforcing (unless shown otherwise on the drawings)
   Bottom of footings 3"
   Formed earth face 3"
   Slab on grade 2" or as noted on drawings

EXCAVATION

1. **General site preparation**:

   a. Excavate under the building foot print down to bedrock or hard mineral soil (gravel or sandy gravel or approved bearing).
   b. Back fill with clean free draining gravel (5% or less fines) in 12" loose lifts. Compact the gravel to 95% of ASTM D1557. Each layer must have a hard and unyielding surface.
   c. All excavation work must conform to all state, local, and federal safety requirements regarding excavations. Shoring and bracing ate the contractor's sole responsibility.
   d. The minimum size of the backfilled area is the size of the building plus 4 feet on every side: 58 feet long x 28 feet.

2. Grade the site at 6" of fall in 10' away from the building.Excavate footings down to the depth shown on the drawings or to firm undisturbed material free of organics. Areas over-excavated shall be backfilled with lean concrete (f'c = 2000 psi), and shall be at the contractor's expense.

3. Backfill shall not be placed until after the removal of all forms, screeds, other wood debris and material subject to rot or corrosion. Back fill shall not be placed until any bracing structural framing: floors, beams, et cetera, have been placed. Do not back fill basement walls until the floor supported by the walls is in place. Use only materials approved for backfill. In areas under slabs or footings, material other than pea gravel should be granular in nature, placed in 6 inch loose lifts and compacted to at least 95% of its maximum dry density as determined by ASTM D1557. The fill should be limited to clean, granular material with less than 5% fines.Pea gravel fill where specified on the drawings shall be a maximum particle size of 3/8" diameter.

3. Place R20 rigid insulation against the outside, vertical face, of the footing extending from the top of the curb to the bottom of the footing. Also, place R20 rigid insulation horizontally away from the footing for 6' and sloping at 6" in 6'. Rigid insulation shall be intended for ground use and exposure to the elements. Protect the exposed face of the insulation with 20 gauge galvanized metal flashing.

4. Compact all fill in 12" loose lifts. All surfaces should be hard and unyielding before placing the next lift.

STEEL:

All detailing, fabrication, and erection shall conform to the AISC Manual of Steel Construction.

1. Steel shall be:

a.	Plates and flat bars:	ASTM A36 or A572,	Fy >= 36 ksi
b.	HSS pipes (Schedule 40 & 80)	ASTM A53, type S,	Fy>= 35 ksi
c.	HSS TS (tube steel)	ASTM A500B,	Fy>= 46 ksi
d.	W, C, & L shapes	ASTM A572 OR 992	Fy >= 50 ksi

2. Bolts:

a.	Machine bolts, anchor bolts, et cetera	ASTM A307
b.	High strength bolts	A325x

3. Tighten all HS bolts as for friction connections. Use snap off bolts.

4. All bolts will be supplied with appropriate nuts and washers for the bolt head and the nut.

5. Welding shall be by AWS certified welders with E70 electrodes in accordance with the current edition of AWS D1.1.

6. All steel members and parts exposed to weather or in contact with the ground shall be galvanized per ASTM A-123 with 1.25 oz. of zinc spelter per square foot of contact area unless noted otherwise. All other steel surfaces shall be shop painted with two coats or red oxide primer after fabrication. Columns and other steel parts placed below grade and exposed to earth shall be painted with two coats of coal tar epoxy paint from the base to 6 inches above grade; such coating to be in addition to the galvanized coating.

CONSTRUCTION DOCUMENTS

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DRAWN: JJR
DATE: 10/23/13

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DATE	BY	CK'D	REVISION
01/09/14	TMP	GMR	REVIEW COMMENT REVISIONS
03/09/15	TMP	GMR	FINAL DOCUMENTS
03/30/15	TMP	GMR	GABLE ROOF REVISION

SHEET CONTENTS: STRUCTURAL NOTES

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: S1.0

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

SCOPE OF WORK

***Purpose*:**

The purpose of this project is two fold:

- Construct a biomass building with the combined uses of biomass storage and heat generation.

General Conditions:

The scope of work below is inclusive and assumes that the contractor will remove, demolish, repair, replace, cleanup, et cetera as necessary for the work.

- All demolition and removal (except as noted) includes offsite disposal at the contractor's expense.
- Materials and conditions are to be as found on sheet S1, 'Structural Notes'.
- The contractor is to provide all necessary shoring and bracing. In addition, the contractor is to keep the building weather tight during the work and to keep the building secure at all times.
- At the end of the project, clean up and restore the building, grounds, and units to an 'as found' or better condition.
- Finishes are to be reviewed and approved by the owners before purchase and installation. The quality is to be 'new' and is subject to review and approval by the project owners and the Engineer of Record.

Scope of work and work sequence:

In order to allow for coordination and verification of actual building conditions, the work will be staged as follows:

Stage 1 - Excavation and Backfill
- a. Stake out the project area.
- b. Excavate the the building area from the ground surface down to bed rock or to dense mineral soils (gravels or sandy-gravels).
- c. Backfill with compacted, free draining gravel with 5% or less fines. Compact in 12" loose lifts and compact to 95% of ASTM D1557. The surface of each lift should be hard and unyielding. The minimum extent of the excavation should be the dimensions of the building plus 4-feet on each side of the building: 58' x 28' or wider. Conform to all state and federal safety requirements regarding excavations, slopes, and shoring and bracing.

2. Stage 2 - Exterior Preparation:
   - a. Construct a 20 foot wide x 50 foot long concrete pad with rolled edges as shown on sheet S5, the foundation plan. Include reinforcing, anchor bolts, and hold downs as shown on the plans. Provide rigid insulation accordance with the Alaska Energy code and as shown on the drawings.

3. Stage 3 - Building construction:
   - a. Construct a wood framed building as shown on the plans and sections.
   - b. Finishes:
     - i. Roof - 22 gauge metal roofing for 130 mph winds.
     - ii. Siding - 22 gauge metal siding to resist a 130 mph wind. Install according to the manufacturer's recommendations and instructions.
     - iii. Interior - 5/8" gypsum wall board, water resistive. Fire block and tape, smooth finish. In the wood storage area use 5/8" plywood for wall sheathing.
     - iv. Painting, interior - Sherwin Williams best quality. Seal the GWB & plywood, then prime with one coat of latex, vapor retarded primer Then paint with two coats of vapor retarder latex paint. Color by owner from Sherwin Williams full range of available colors.
     - v. Concrete, exterior - light broom.
     - vi. Concrete, interior - smooth. Do not over finish. Leave a light bite in the surface for safety when the concrete is wet.

4. Stage 4 - Project closeout.
   - a. Verify that all finishes are in 'as new condition' and that any finishes damaged on adjacent buildings or site work are restored to as new condition.
   - b. Paint all new trim and siding with 1 coat of primer and two coats of exterior grade oil paint to match the existing, adjacent, buildings. Paint to be Sherwin Williams best grade and applied in strict accordance to the manufacturer's instructions.
   - c. Clean up, restore, and plant the work area to match the surrounding landscaping. Leave the building and grounds in 'as found' condition for all materials and site conditions that remain. Clean up work and landscaping must be approved by the owner and engineer before the project is complete.
   - d. Clean up and restore the project site.

TYPICAL SHEAR WALL NOTES

Anchor Bolts (AB's) shall be sized as shown on the plans or in the notes shear wall table below. Unless otherwise specified all anchor bolts shall be 12" long with not less than 7" of embedment in the concrete. All anchor bolts shall have at least 1" of exposure above the top of the wall plate or plates. Anchor bolts shall be spaced as shown on the drawings but not less than noted in the shear wall table below. In the case of conflicts, use the closer spacing. Anchor bolts shall have 3 x3 x 1/4" steel plate washers. Locate the center of all shear wall anchor bolts at 2" from the inside face of shear wall sheathing. In the case of walls with sheathing on both sides, locate the bolt 2" from the exterior side sheathing.

All wall sheathing shall be 1/2" CDX plywood or 7/16" OSB with exterior exposure glue and span rated "SR 24/0" or better, unless noted otherwise. In the event of conflicts, use the thicker sheathing. All free sheathing edges shall be blocked with 2x4 or 2x6 flat blocking. Any exceptions will be noted explicitly on the drawings or the shear wall notes below.

Panels shall not be less than 4' x 8' except at boundaries and changes in framing where minimum panel dimensions shall be 24". Where required by the panel dimensions, small sheets may be used where all panel edges are supported by framing and blocking. ***Regardless of other circumstances, all panels must be supported on two sides by wall studs.***

All nails shall be common nails (see the Structural Notes). Edge nail spacing shall be as noted below but not less than 6" on centers. Space nails at 8" on centers in the field. Nails shall be located at least 3/8" from edges and ends of panels.

Connection hardware and hold downs are Simpson "Strong Tie" and shall be installed per the Manufacturer's recommendations and instructions.

Pressure treated material requires that all fasteners and connectors must be "post" hot dipped galvanized. Galvanizing shall be ASTM A123 for connectors and ASTM A153 for fasteners. Simpson "Zmax" is an acceptable equal per ASTM A653. Stainless steel fasteners and connectors are also acceptable for pressure treated wood. When using stainless steel or hot dipped galvanized connectors, the connectors and fasteners must be made of the same material.

All roof and wall framing lumber shall be #2 Douglas Fir-Larch or better.

SHEAR WALL SCHEDULE

W-1 (365) 1/2" Sheathing nailed with 8d's (.131 dia.) at 6" on center all edges.

W-3 (685) 1/2" Sheathing nailed with 8's (.131 dia.) at 3" on center all edges. All framing shall not be less than a single 3x member. Stagger nails at adjacent panel edges

W-7 (1790) 5/8" or 3/4" sheathing on the wood storage part of the building and 1/2" sheathing on the boiler side of the wall nailed with 8d's (.131" dia.) at 2" on center all edges. All framing members shall not be less than a single 3x member. Stagger nails at the adjacent panel edges. Panel joints on opposite sides of the wall shall be offset to fall on different framing members.

CONSTRUCTION DOCUMENTS

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DATE: 10/23/13

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REVISION	CK'D	BY	DATE
REVIEW COMMENT REVISIONS	GMR	TMP	01/09/14
FINAL DOCUMENTS	GMR	TMP	03/09/15
GABLE ROOF REVISION	GMR	TMP	03/30/15

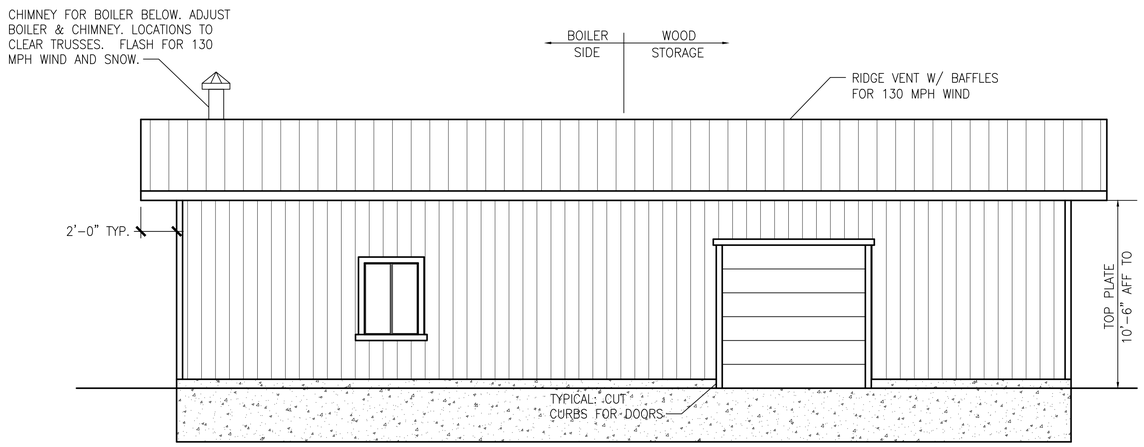
SHEET CONTENTS: SCOPE OF WORK AND SHEAR WALL NOTES

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

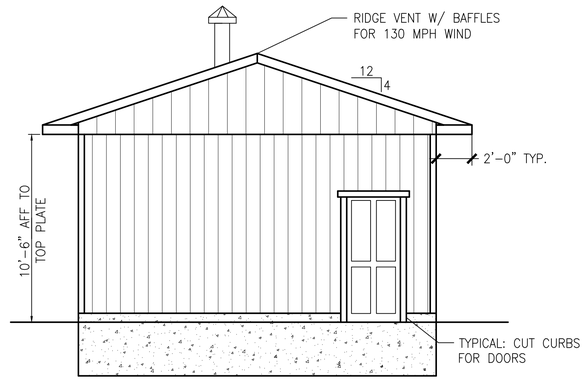
SHEET: S2.0

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.



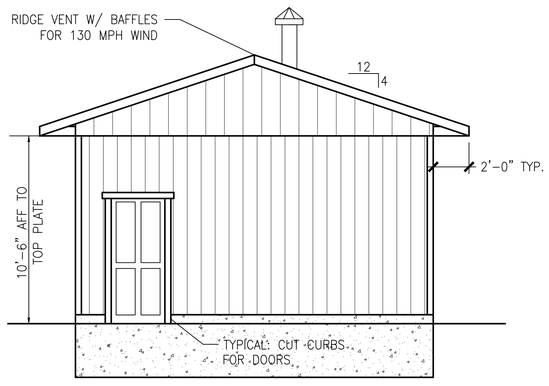
FRONT ELEVATION

SCALE: 1/4" = 1'-0"



RIGHT ELEVATION

SCALE: 1/4" = 1'-0"



LEFT ELEVATION

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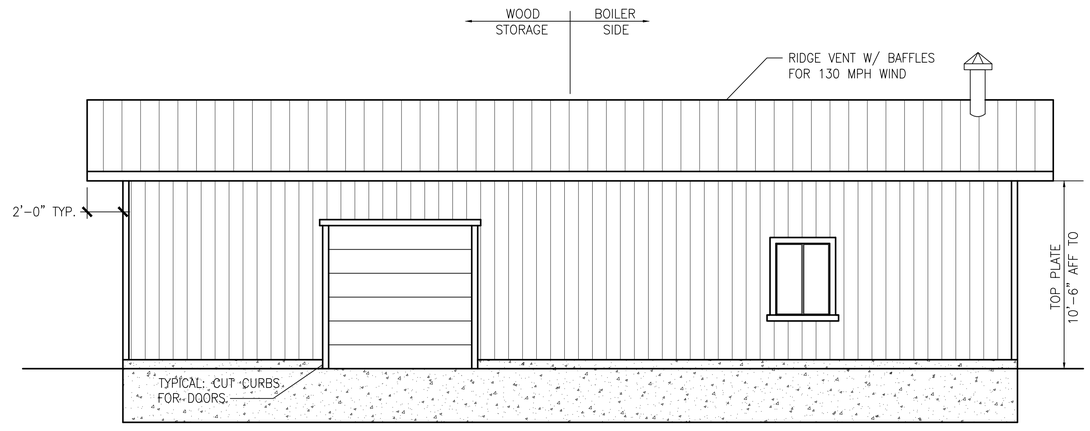

REAR ELEVATION

SCALE: 1/4" = 1'-0"

CONSTRUCTION DOCUMENTS

DESIGNED: JVM
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REVIEW COMMENT REVISIONS	01/09/14	TMP	GMR
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GABLE ROOF REVISION	03/30/15	TMP	GMR

SHEET CONTENTS: ELEVATIONS

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: S3.0

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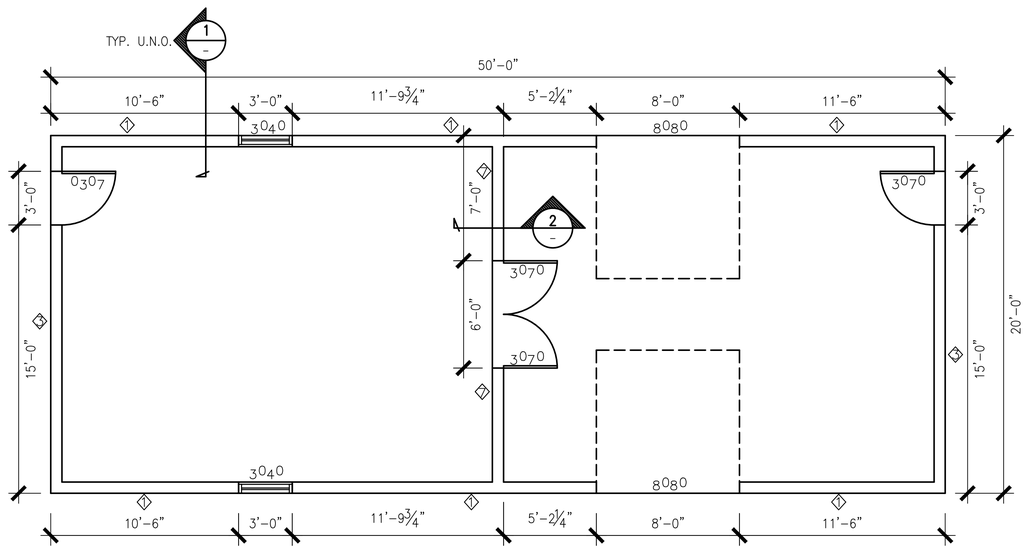
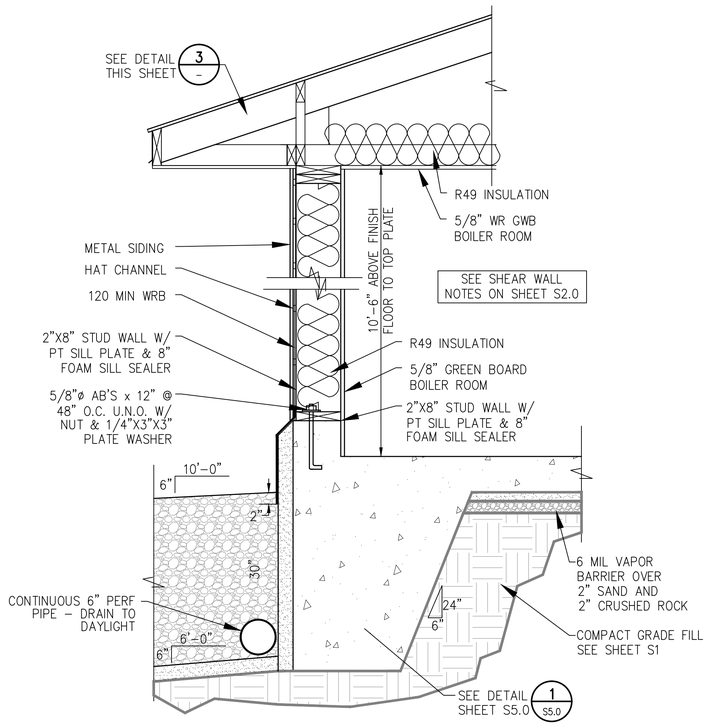
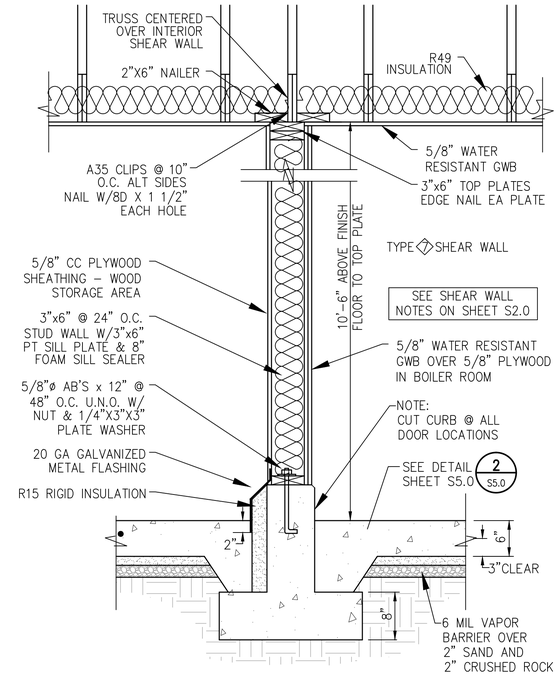


FLOOR PLAN
SCALE: 1/4" = 1'-0"



1 S4.0 EXTERIOR WALL SECTION DETAIL
SCALE: 1" = 1'-0"



2 S4.0 INTERIOR WALL SECTION DETAIL
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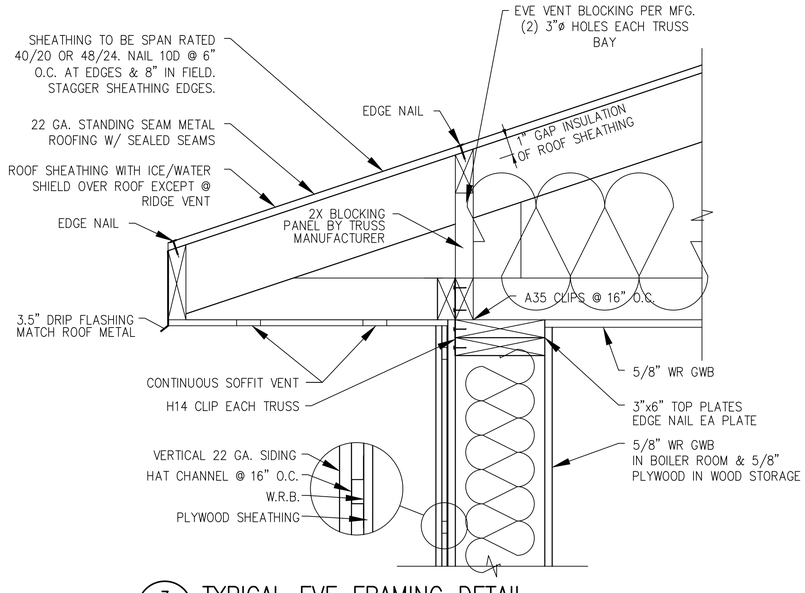

3 S4.0 TYPICAL EVE FRAMING DETAIL
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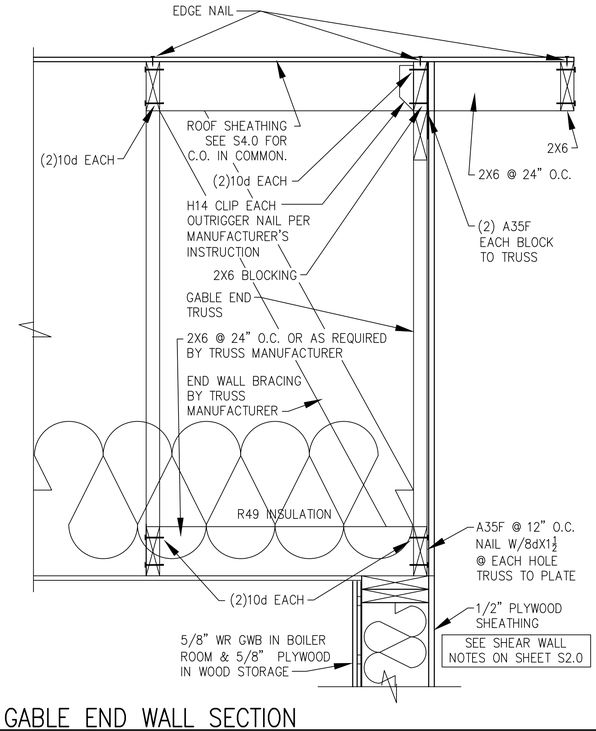

4 S4.0 GABLE END WALL SECTION
SCALE: N.T.S.

CONSTRUCTION DOCUMENTS

DESIGNED: JVM
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REVISION	DATE	BY	CK'D
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FINAL DOCUMENTS	03/09/15	TMP	GMR
GABLE ROOF REVISION	03/30/15	TMP	GMR

SHEET CONTENTS: FLOOR PLAN & SECTION DETAILS
TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663
PROJECT NO.: 5222
SHEET: S4.0

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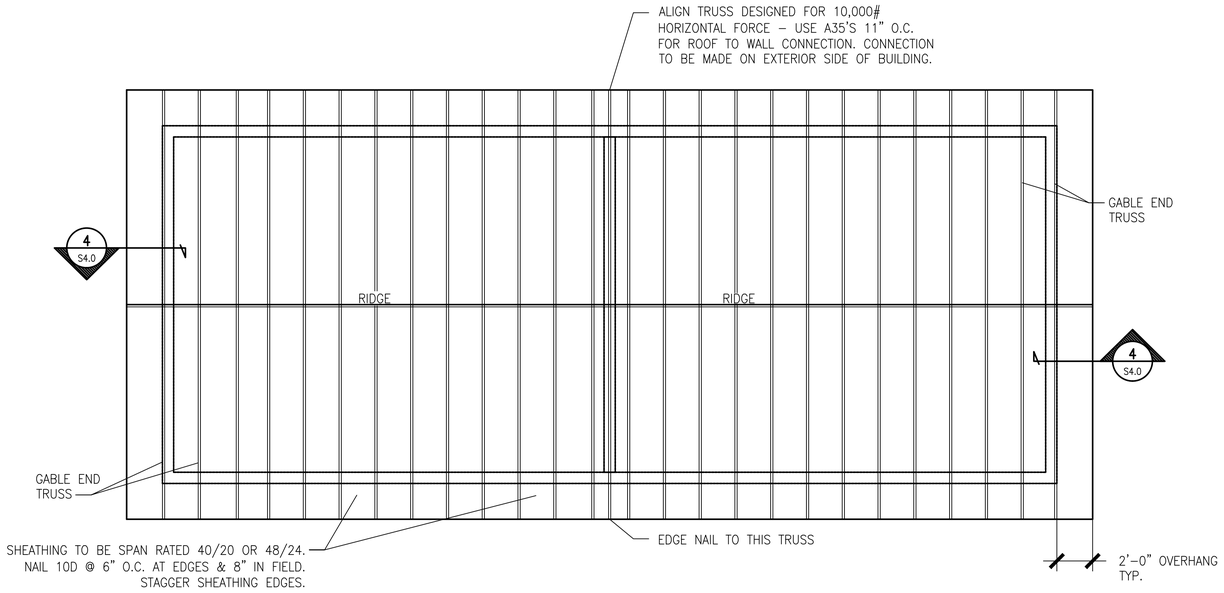
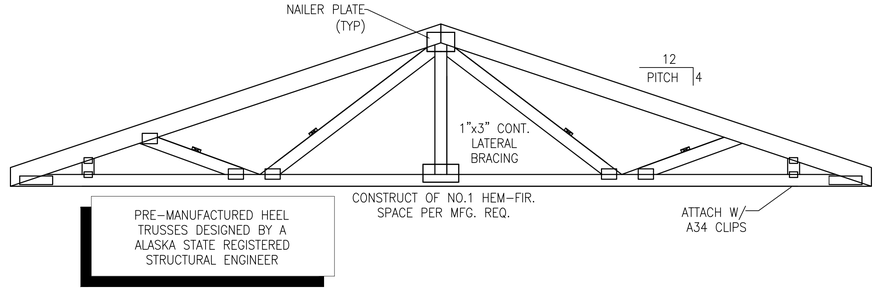
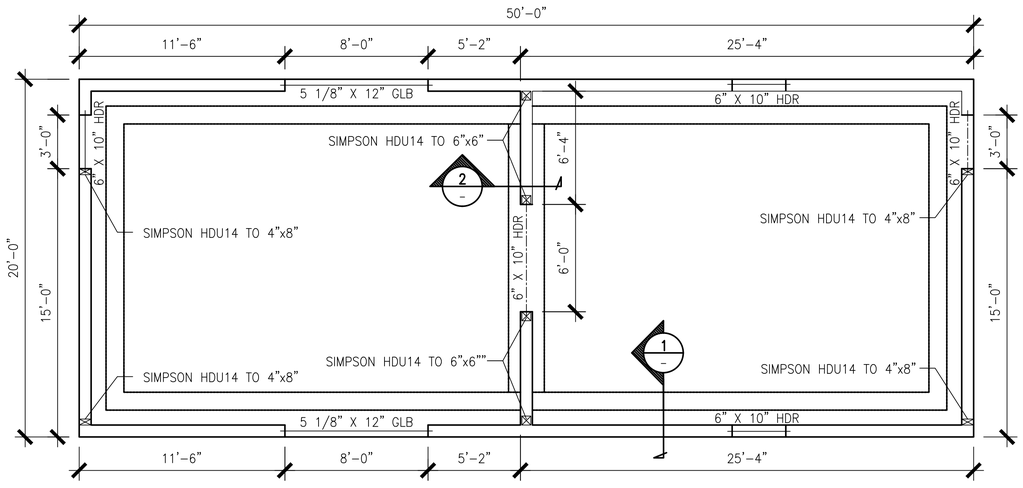
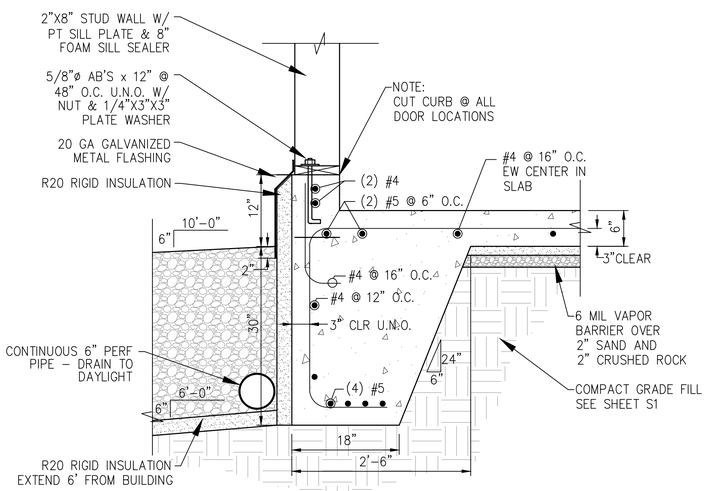


ROOF PLAN
SCALE: 1/4" = 1'-0"





FOUNDATION PLAN
SCALE: 1/4" = 1'-0"



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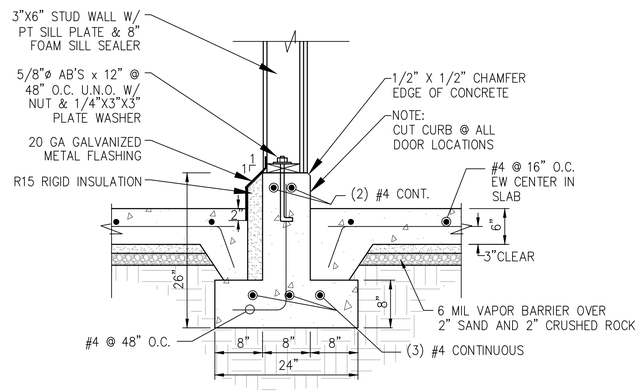

2 S5.0 INTERIOR FOUNDATION SECTION
SCALE: 1" = 1'–0"

CONSTRUCTION DOCUMENTS

DESIGNED: JVM
DRAWN: JJR
DATE: 10/23/13

PREPARED BY:

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George M. Richmond
ME 10217
REGISTERED PROFESSIONAL ENGINEER

REVISION	CK'D	BY	DATE
REVIEW COMMENT REVISIONS	GMR	TMP	01/09/14
FINAL DOCUMENTS	GMR	TMP	03/09/15
GABLE ROOF REVISION	GMR	TMP	03/30/15

SHEET CONTENTS: ROOF / FOUNDATION PLAN & DETAILS
PROJECT NO.: 5222
TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663
SHEET: S5.0

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

HVAC SYMBOLS

DUCTWORK - LEGEND SINGLE LINE	DUCTWORK - LEGEND DOUBLE LINE	
12/20	12/20	DUCT SIZE (FIRST FIGURE IS SIDE SHOWN)
12/20 (E)	12/20 (E)	EXISTING DUCT SIZE (FIRST FIGURE IS SIDE SHOWN)
8x4∅	8x4∅	FLAT OVAL DUCT SIZE (FIRST FIGURE IS SIDE SHOWN)
		RETURN AIR FLOW DIRECTION
		SUPPLY AIR FLOW DIRECTION
12x12 UP		RECTANGULAR DUCT SUPPLY AIR – TURNING UP OR TOWARD
12x12 DN		RECTANGULAR DUCT SUPPLY AIR – TURNING DOWN OR AWAY
		RECTANGULAR DUCT RETURN AIR – TURNING UP OR TOWARD
		RECTANGULAR DUCT RETURN AIR – TURNING DOWN OR AWAY
		RECTANGULAR DUCT EXHAUST AIR – TURNING UP OR TOWARD
		RECTANGULAR DUCT EXHAUST AIR – TURNING DOWN OR AWAY
		RECTANGULAR DUCT OUTSIDE AIR – TURNING UP OR TOWARD
		RECTANGULAR DUCT OUTSIDE AIR – TURNING DOWN OR AWAY
12"ø UP		ROUND DUCT – TURNING UP OR TOWARD
12"ø DN		ROUND DUCT – TURNING DOWN OR AWAY
8x4∅ UP		OVAL DUCT – TURNING UP OR TOWARD
8x4∅ DN		OVAL DUCT – TURNING DOWN OR AWAY
UP	UP	CHANGE OF ELEVATION RISE (UP) DROP (DN)
		TRANSITION
	12/12 12"ø	SQUARE TO ROUND DUCT TRANSITION
		TURNING VANES
POC	POC	POINT OF CONNECTION (EXISTING TO NEW)
		VOLUME DAMPER
		FLEXIBLE CONNECTION
		ACOUSTICALLY LINED METAL DUCT
12"ø		FLEX DUCT
		DUCT END CAP
		BACKDRAFT DAMPER (BDD) OR COUNTER-BALANCED BACKDRAFT DAMPER (CBBDD) AS NOTED

SIZE
SCHEDULE ID TAG
EXISTING
8x8 SD (E)
3000 CFM ← DESIGN AIR CFM
TYP OF 4 ← QUANTITY

DIFFUSER CALLOUT

HVAC SYMBOLS

FCU-1	EQUIPMENT CALLOUT
CO2	CO2 SENSOR
	CONVECTOR
	ROUND DUCT END
M	MOTORIZED DAMPER
FS	COMBINATION FIRE/SMOKE DAMPER
	FIRE DAMPER
	SMOKE DAMPER
S	SMOKE DETECTOR, DUCT TYPE
	RETURN GRILLE
	SUPPLY DIFFUSER
	EXHAUST GRILLE
	WALL DIFFUSER
	WALL GRILLE (RETURN OR EXHAUST)
DG	DOOR GRILLE
	THERMOMETER
T	THERMOSTAT/TEMPERATURE SENSOR
	UNIT HEATER

PLUMBING SYMBOLS

	SAWCUT
	THERMOMETER
	PIPE FLEXIBLE CONNECTION
	AUTO BALANCING VALVE
	WATER HAMMER ARRESTOR (WHA)
	SPRINKLER
	CIRCUIT SETTER
	BUTTERFLY VALVE
	TRIPLE DUTY VALVE
	AIR VENT
	AUTOMATIC AIR VENT (AAV)
	PRESSURE GAUGE
	FIRE DEPARTMENT CONNECTION
	FUNNEL DRAIN
	FUNNEL FLOOR DRAIN (FFD)
	FLOOR DRAIN (FD)
	ANCHOR
	FLOW ARROW
M	METER
	PUMP
	THREE-WAY CONTROL VALVE
	CONTROL VALVE
	OS&Y VALVE
	WYE STRAINER
	FLOOR SINK
	REDUCED PRESSURE BACKFLOW PREVENTOR ASSEMBLY (RPBA)
	PRESSURE REDUCING VALVE
	PRESSURE RELIEF VALVE
	GAS COCK
	GAS PRESSURE REGULATOR
	PLUG VALVE
	CHECK VALVE
	GATE VALVE
	BALL VALVE
	GLOBE VALVE
	VALVE IN PIPE DN
	VALVE IN PIPE UP
	FREEZEPROOF WALL HYDRANT HYDRANT (FPWH) OR HOSE BIBB (HB) AS INDICATED
	UNION
	WALL CLEANOUT (WCO)
	FLOOR CLEANOUT (FCO) OR SURFACE CLEANOUT (SCO) AS INDICATED
	45° ELBOW
	CAP
	90° ELBOW
	TEE
	PIPE DOWN
	PIPE UP
	TEE UP
	TEE DOWN

LINE TYPES

	COLD WATER SUPPLY (CW)
	HOT WATER SUPPLY (HW)
	HOT WATER RECIRCULATION (HWR)
	VENT
	WASTE
SS	SANITARY SEWER
F	FIRE
FDC	FIRE DEPARTMENT CONNECTION
CND	CONDENSATE
OFD	OVERFLOW DRAIN
CWS	CHILLED WATER SUPPLY
CWR	CHILLED WATER RETURN
HWS	HEATING WATER SUPPLY
HWR	HEATING WATER RETURN
RL	REFRIGERANT LIQUID
RV	REFRIGERANT VAPOR
G	NATURAL GAS
P	PROPANE
STM	STEAM SUPPLY
A	COMPRESSED AIR
	DEMO

ABBREVIATIONS

ACU	AIR CONDITIONING UNIT	FCO	FLOOR CLEAN OUT	OV	OUTLET VELOCITY
AFF	ABOVE FINISHED FLOOR	FCU	FAN COIL UNIT		
AFG	ABOVE FINISHED GRADE	FD	FLOOR DRAIN	P	PUMP
AHU	AIR HANDLING UNIT	FDC	FIRE DEPARTMENT CONNECTION	PD	PRESSURE DROP
ARCH	ARCHITECT/ARCHITECTURAL	FFD	FUNNEL FLOOR DRAIN	PG	PROPYLENE GLYCOL
AS	AIR SEPARATOR	FID	FIRE DAMPER	POC	POINT OF CONNECTION
APD	AIR PRESSURE DROP	FLR	FLOOR	PPH	POUNDS PER HOUR
ADA	AMERICANS WITH DISABILITIES ACT	FP	FIRE PUMP	PRV	PRESSURE REDUCING VALVE
		FPI	FINS PER INCH	PSI	POUNDS PER SQUARE INCH
BDD	BACK DRAFT DAMPER	FPM	FEET PER MINUTE	PSID	POUNDS PER SQUARE INCH DIFFERENTIAL
BF	BARRIER FREE	FPS	FEET PER SECOND	PSIG	POUNDS PER SQUARE INCH GAUGE
BFP	BACK FLOW PREVENTER	FPWH	FREEZE PROTECTED WALL HYDRANT		
BHP	BRAKE HORSEPOWER	FS	FLOOR SINK	RA	RETURN AIR
BI	BACKWARD INCLINE	FT	FOOT, FEET	RD	ROOF DRAIN
BOG	BOTTOM OF GRILLE	FV	FACE VELOCITY	REF	REFERENCE
BTUH	BRITISH THERMAL UNIT PER HOUR			RF	RELIEF FAN
BV	BALL VALVE			RG	RETURN GRILLE
		GA	GAUGE	RH	RELATIVE HUMIDITY
CAP	CAPACITY	GAL	GALLONS	RPBA	REDUCED PRESSURE BACK FLOW ASSEMBLY
CC	COOLING COIL	GALV	GALVANIZED	RPM	REVOLUTIONS PER MINUTE
CFM	CUBIC FEET PER MINUTE	GPM	GALLONS PER MINUTE		
CFSD	COMBINATION FIRE/SMOKE DAMPER	GV	GATE VALVE	SEER	SEASONAL ENERGY EFFICIENCY RATIO
CH	CABINET HEATER	GWB	GYPSUM WALLBOARD	SA	SUPPLY AIR
CI	CAST IRON			SCO	SURFACE CLEAN OUT
CLG	CEILING, COOLING	HB	HOSE BIBB	SD	STORM DRAIN
CND	CONDENSATE	HC	HEATING COIL	SF	SUPPLY FAN
CO	CLEAN OUT	HP	HEAT PUMP UNIT	SG	SUPPLY GRILLE
COND	CONDENSER	HRU	HEAT RECOVERY UNIT	SL	SOUND LINE
CONT	CONTINUE	HVAC	HEATING, VENTILATING, & AIR CONDITIONING	SMACNA	SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION
CP	CIRCULATING PUMP	HWR	HEATING WATER RETURN		
CRU	COMPUTER ROOM AIR CONDITIONING UNIT	HWS	HEATING WATER SUPPLY	SP	STATIC PRESSURE
CSTC	CRUSHED SURFACING TOP COURSE	HX	HEAT EXCHANGER	SPKR	SPRINKLER
CT	COOLING TOWER			SS	SANITARY SEWER
CU	CONDENSING UNIT	IBC	INTERNATIONAL BUILDING CODE	ST	SOUND TRAP
CU FT	CUBIC FEET	ID	INDIRECT DRAIN	STM	STEAM
Cv	FLOW COEFFICIENT	IE	INVERT ELEVATION	STRUC	STRUCTURAL
CV	CONSTANT VOLUME	INT	INTERIOR	SW	SWITCH
CWS	CHILLED WATER SUPPLY	INWC	INCHES WATER COLUMN	SWG	SIDE WALL GRILLE
CWR	CHILLED WATER RETURN				
		LAT	LEAVING AIR TEMPERATURE	TG	TRANSFER GRILLE
DB	DRY BULB	LWT	LEAVING WATER TEMPERATURE	TOD	TOP OF DUCT
DCVA	DOUBLE CHECK VALVE ASSEMBLY			TOF	TOP OF FOOTING
DDC	DIRECT DIGITAL CONTROL	MAX	MAXIMUM	TOJ	TOP OF JOIST
DIA	DIAMETER	MB	MIXING BOX	TOP	TOP OF PIPE
DISCH	DISCHARGE	MBH	THOUSAND BTU PER HOUR	TP	TRAP PRIMER
DN	DOWN	MC	MECHANICAL CONTRACTOR	TSP	TOTAL STATIC PRESSURE
DW	DISH WASHER	MFR	MANUFACTURER		
DWG	DRAWING	MTD	MOUNTED	UH	UNIT HEATER
		MTR	MOTOR	UNO	UNLESS NOTED OTHERWISE
(E)	EXISTING				
EA	EACH	N/A	NOT APPLICABLE	V	VENT
EC	ELECTRICAL CONTRACTOR	NC	NORMALLY CLOSED	VAV	VARIABLE AIR VOLUME
EAT	ENTERING AIR TEMPERATURE	NEC	NATIONAL ENERGY CODE	VB	VALVE BOX
EDH	ELECTRIC DUCT HEATER	NIC	NOT IN CONTRACT	VD	VOLUME DAMPER
EF	EXHAUST FAN	NO	NORMALLY OPEN	VFD	VARIABLE FREQUENCY DRIVE
EG	EXHAUST GRILLE	NBR	NUMBER	VTR	VENT THROUGH ROOF
EL	ELEVATION	NREC	NON-RESIDENTIAL ENERGY CODE		
ESP	EXTERNAL STATIC PRESSURE	NTS	NOT TO SCALE	W	WASTE
ET	EXPANSION TANK			WB	WET BULB
EVAP	EVAPORATOR	OBD	OPPOSED BLADE DAMPER	WCO	WALL CLEAN OUT
EWT	ENTERING WATER TEMPERATURE	OC	ON CENTER	WG	WATER GAUGE
EXH	EXHAUST	OD	OUTSIDE DIAMETER	WH	WATER HEATER
EXP	EXPANSION	OFD	OVERFLOW DRAIN	WHA	WATER HAMMER ARRESTER
EXT	EXTERNAL	ORD	OVERFLOW ROOF DRAIN	WPD	WATER PRESSURE DROP
		OSA	OUTSIDE AIR	WSEC	WASHINGTON STATE ENERGY CODE
F	FAHRENHEIT	OS&Y	OUTSIDE STEM & YOKE		

DRAWING CONVENTIONS

A / M4.2 **SECTION TITLE** — TO BE DETERMINED
SECTION TITLE UNDERLINE, M4.2 = REFERENCE WHERE SECTION IS TAKEN

1 / M4.2 **DETAIL TITLE** — TO BE DETERMINED
DETAIL TITLE UNDERLINE, M4.2 = REFERENCE WHERE DETAIL IS TAKEN

1 / M4.2 **ELEVATION TITLE** — SCALE: TO BE DETERMINED
ELEVATION TITLE UNDERLINE, M4.2 = REFERENCE WHERE ELEVATION IS TAKEN

N — NORTH ARROW

A / M4.2 — A = SECTION NUMBER, M4.2 = SHEET WHERE SECTION IS DRAWN

1 / M4.2 — 1 = DETAIL NUMBER, M4.2 = SHEET WHERE DETAIL IS DRAWN

1 / M4.2 — 1 = ELEVATION NUMBER, M4.2 = SHEET WHERE ELEVATION IS DRAWN

3 — KEY NOTE

1 — REVISION REFERENCE

MECHANICAL NOTES

1. UPON COMPLETION CALIBRATE AND TEST MECHANICAL SYSTEM.
2. INSULATE ALL PIPING PER CURRENT IMC.

CONSTRUCTION DOCUMENTS

DESIGNED: GMR
DRAWN: TMP
DATE: 10/23/13

PREPARED BY:
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REVISION	BY	CK'D	DATE
REVIEW COMMENT REVISIONS	TMP	GMR	01/09/14
FINAL DOCUMENTS	TMP	GMR	03/09/15

SHEET CONTENTS: MECHANICAL LEGEND

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: M0.1

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

BOILER SCHEDULE

ID	TYPE	MFR / MODEL	OUTPUT (MAX)	EFFICIENCY	WEIGHT (LBS)	ELECTRICAL		FLUE	AIR INTAKE
						DRAFT MOTOR	V/PH		
B-1	WOOD FIRED BOILER	GARN WHS 3200	700,000 BTUH	85%	7,500 EMPTY; 34,500 FULL	1HP	115/1/60 20 AMP CIRCUIT	10"ID CLASS A	9" SCREENED

BOILER PLUMBING

BOILER SUPPLY	3" FLANGE
BOILER RETURN	2 1/2" mpt SCH 40
CONNECTION FOR EXTINGUISHING WATER	R 3/4"

BOILER CHAMBER SIZE AND FUEL

COMBUSTION CHAMBER LENGTH	50"
COMBUSTION CHAMBER DIAMETER	40"
RECOMMENDED WOOD LENGTH	24" to 42"

NOTES:
1. CHEMICAL TREATMENT FOR BOILER STARTUP WILL BE PROVIDED AFTER TESTING OF WATER SAMPLE PER MANUFACTURER'S REQUIREMENTS.

HEAT EXCHANGER SCHEDULE

ID	SERVES	MFR	MODEL	CENTRAL BOILER GPM	CENTRAL BOILER INLET °F	CENTRAL BOILER OUTLET °F	BUILDING HEATING SYSTEM GPM	BUILDING HEATING SYSTEM INLET °F	BUILDING HEATING SYSTEM OUTLET °F	BUILDING HEATING SYSTEM PRESS DROP (FT)	NOTES
HX-1	SAFETY BUILDING	HYDRONIC	LB31-40		180°	150°	8.0	140°	170°	3.5	1
HX-2	PACIFIC RIM	HYDRONIC	LB31-40		180°	150°	3.5	140°	170°	3.5	1
HX-3	HEALTH AND DENTAL	HYDRONIC	LB31-40		180°	150°	9.5	140°	170°	3.5	1
HX-4	TRIBAL COUNCIL	HYDRONIC	LB31-60		180°	150°	20.0	140°	170°	3.5	1
HX-5	OFFICE/MUSEUM	HYDRONIC	LB31-40		180°	150°	5.0	140°	170°	3.5	1
HX	BOILER ROOM	AURORA	AP57H-60	40.0	190°	160°	46	150°	180°	2.5	1

NOTES: 1. BRAZED PLATE HEAT EXCHANGER OR EQUAL.

PUMP SCHEDULE

ID	MFR / MODEL	SERVICE	TYPE	CAPACITY GPM	CAPACITY HEAD FT	CAPACITY HP	CAPACITY RPM	CAPACITY SIZE	ELECTRICAL VOLTS	ELECTRICAL DISC.	NOTES
CP-1	ARMSTRONG / 4360	HEATING LOOP	VERTICAL INLINE	46	50	1.5	1800	1.5D	240/1/60	EC	1
SPARE	ARMSTRONG / 4360	HEATING LOOP	VERTICAL INLINE	46	50	1.5	1800	1.5D	240/1/60	EC	1, 2
CP-2	ARMSTRONG / 4360	BOILER PUMP	VERTICAL INLINE	40	25	1.5	1800	2B	240/1/60	EC	1
SPARE	ARMSTRONG / 4360	BOILER PUMP	VERTICAL INLINE	40	25	1.5	1800	2B	240/1/60	EC	1, 2

NOTES:
1. OR EQUAL.
2. STORE SPARE PUMP IN BOILER ROOM.

EXHAUST FAN SCHEDULE

ID	AREA SERVED	MFR	MODEL	TYPE	FAN CFM	FAN SP	FAN RPM	FAN HP / WATTS	FAN VOLT / PH	FAN STARTER/MOTOR RATED BY	FAN DISCONNECT BY	NOTES
EF-1	BIOMASS BOILER ROOM	GREENHECK	CW 070-G	SIDEWALL EXHAUST	200	0.20	1300	1/60 HP	240/1	MFR	EC	1,2,3

NOTES:
1. OR EQUAL.
2. PROVIDE W/BACKDRAFT DAMPER AND BIRDSCREEN.
3. UNIT SHALL BE SWTICHED VIA WALL SWITCH PROVIDED BY EC.

INSULATION OF PIPE

USAGE	PIPE SIZE (INCHES)	LOCATION	INSULATION MATERIAL	INSULATION THICKNESS	CONDUCTIVITY	NOTES
CW	ALL	OVERHEAD	FIBERGLASS	1/2"	-	
CW	ALL	WALLS	NOT REQUIRED			
	1" TO 2"	ALL	FIBERGLASS	1-1/2"	024 - 0.28	

COMMENTS:
1. ALL PIPING INSULATION SHALL MEET NREC.
2. ALL PIPING INSULATION AND COVERINGS SHALL HAVE AN ASTM FLAME SPREAD RATING OF 25 OR LESS AND AN ASTM SMOKE DEVELOPED RATING OF 50 OR LESS.
3. PROVIDE VAPOR BARRIER COVERING ON ALL ROOF DRAIN, RAIN LEADER, AND CW PIPING INSULATION.
4. MUST MEET ALASKA ENERGY CODE.

STORAGE TANK

ID	MFR	MODEL	SIZE (DIA x H)	TANK SIZE	TANK LINING	NOTES
ST-1	AO SMITH	HD 20-100	20"/72"	100 GAL	CONCRETE	1,2,3,4

NOTES:
1. TANK SHALL BE CONSTRUCTED AND STAMPED ACCORDING TO ASME SPECIFICATIONS.
2. CONCRETE LINED TANK TO BE EQUIPPED WITH MAGNESIUM ANNODE RODS.
3. TANK SHALL BE VERTICAL.
4. TANK TO BE INSULATED.
5. OR EQUAL

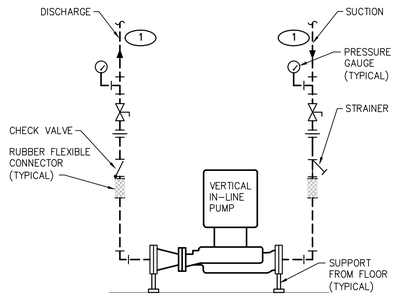
EXPANSION TANK/AIR SEPARATOR SCHEDULE

ID	MFR	MODEL	SIZE	TOTAL VOLUME	MATERIAL	DIAPHRAGM
ET-1	THERM-X-TROL	ST-80V-C	24" DIA/40-1/2" H ASME	53 GALLONS	STEEL	YES
AS-1	SPIROTHERM	VJR-075TM	3/4" CONNECTION	-	STEEL	-

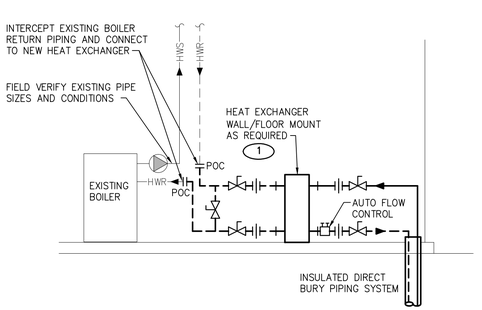
NOTES:
1. OR EQUAL.

KEY NOTES:

(1) INSULATE COPPER LINES PER IMC.

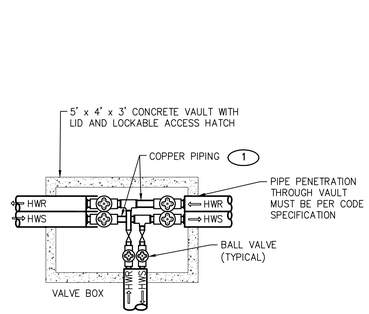


1 M0.2 PUMP INSTALLATION DETAIL
SCALE: NONE

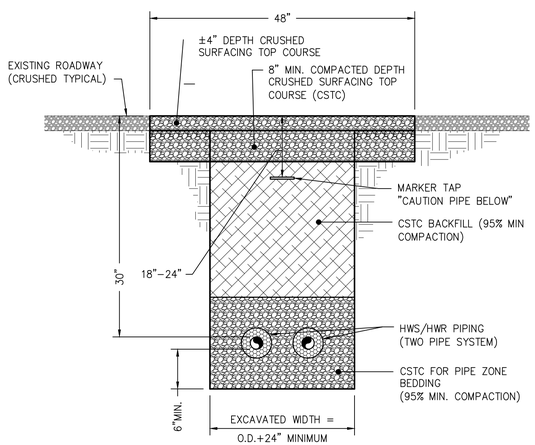


2 M0.2 TYPICAL BUILDING CONNECTION DETAIL
SCALE: NONE

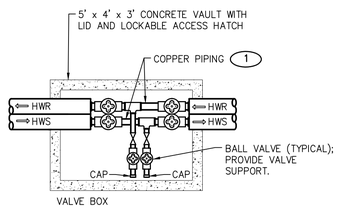
NOTE: PACIFIC RIM BUILDING RECEIVES BRANCH PIPING AND HEAT ENCHANGER. BUILDING CONNECTIONS ARE FUTURE.



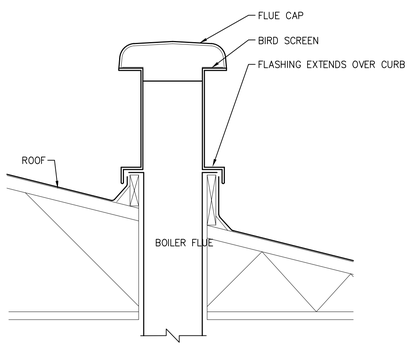
3 M0.2 VAULT DETAIL
SCALE: NONE



4 M0.2 PIPE TRENCH DETAIL
SCALE: NOT TO SCALE



5 M0.2 FUTURE CONNECTION VAULT DETAIL
SCALE: NONE



6 M0.2 FLUE DETAIL
SCALE: NONE

CONSTRUCTION DOCUMENTS

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

DESIGNED: SAR
DRAWN: TMP
DATE: 10/23/13

PREPARED BY:
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STATE OF ALASKA 49th
George M. Richmond
ME 10217
REGISTERED PROFESSIONAL ENGINEER

DATE	BY	CK'D	REVISION
01/09/14	TMP	GMR	REVIEW COMMENT REVISIONS
03/09/15	TMP	GMR	FINAL DOCUMENTS

SHEET CONTENTS: MECHANICAL SCHEDULES AND DETAILS
PROJECT NO.: 5222
TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663
SHEET: M0.2

HYDRONIC SCHEDULE			
BUILDING	BTU	BRANCH DIAMETER (INCHES)	BRANCH LENGTH (x2)
PUBLIC SAFETY	118,000	1-1/4"	50
PACIFIC RIM	53,000	1"	80
HEALTH AND DENTAL	141,000	1-1/4"	120
TRIBAL COUNCIL	295,000	2	25
NATIVE CORP/MUSEUM	71,000	1	120
TOTAL BTU	**678,000**		

SHEET NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES, INCLUDING THE INVERTS AND TOP ELEVATIONS AT CROSSING AND CONNECTION LOCATIONS, PRIOR TO THE START OF CONSTRUCTION. AND TO NOTIFY THE ENGINEER OF ANY POTENTIAL CONFLICTS. THE CONTRACTOR SHALL DIG TEST HOLES OVER ALL UTILITY CROSSINGS/CONNECTIONS TO DETERMINE THEIR EXACT LOCATION.
2. DRAWING SHOWS ROUTING AND DISTANCE, NOT NUMBER OF PIPES.
3. PROVIDE DIRECT BURY HYDRONIC PIPING PER SPECIFICATIONS.
4. DISTRIBUTION PIPING SIZE CHANGES TAKE PLACE IN VALVE BOXES.
5. CONTRACTOR TO DETERMINE BEST PIPING ACCESS INTO BUILDINGS. ALL PENETRATIONS SHALL BE CAULKED WEATHERTIGHT.

EXISTING CW LINE
BIOMASS HEATING PLANT FACILITY
EXISTING BOILER SECOND FLOOR
4 M0.2 TYPICAL TRENCH DETAIL
HX-1
BIOMASS BOILER
GRAHAM ROAD
2"HWS, 2"HWR
PUBLIC SAFETY BLDG
VALVE BOX
3 M0.2 (TYPICAL)
HEAT EXCHANGER BUILDING CONNECTION
2 M0.2 (TYPICAL)
EXISTING OIL STOVE
HX-2
PACIFIC RIM SHOP
RUNWAY
SEPARATE ELECTRIC HW TANK IN COUNCIL BLDG
EXISTING OIL BOILER
HX-3
HEALTH AND DENTAL CLINIC
TRIBAL COUNCIL BLDG
GENERATOR BLDG
2"HWS, 2"HWR
HEAT EXCHANGER BUILDING CONNECTION 6 M0.2
GRAHAM ROAD
EXISTING OIL BOILER (HEAT/HOT WATER)
HX-4
GENERATOR BLDG
TWO EXISTING BOILERS FOR COUNCIL BLDG
1-1/2"HWS, 1-1/2"HWR
RESIDENCE (FUTURE CONNECTION)
EXISTING OIL BOILER (HEAT/HOT WATER)
EXISTING OIL BOILER
HX-5
NATIVE CORP OFFICE/MUSEUM
1-1/2"HWS, 1-1/2"HWR
5 M0.2 FUTURE CONNECTION VAULT DETAIL
RESIDENCE (FUTURE CONNECTION)
RESIDENCE (FUTURE CONNECTION)
EXISTING OIL BOILER (HEAT/HOT WATER)
CEMETERY ROAD

VILLAGE SITE PLAN - HYDRONIC LOOP

SCALE: 1" = 25'-0"

SCALE: 1" = 25'
0 12.5 25 50

CONSTRUCTION DOCUMENTS

DESIGNED: SAR
DRAWN: TMP
DATE: 10/23/13

PREPARED BY:
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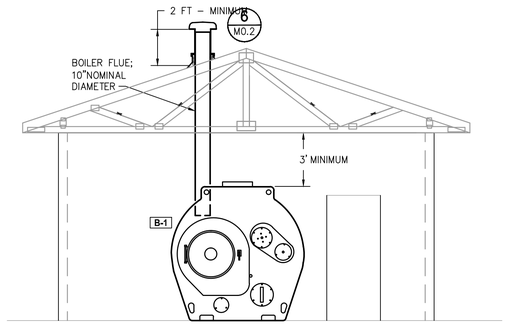
REVISION	BY	CK'D	DATE
REVIEW COMMENT REVISIONS	TMP	GMR	01/09/14
FINAL DOCUMENTS	TMP	GMR	03/09/15

SHEET CONTENTS: VILLAGE SITE PLAN – HYDRONIC LOOP

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222
SHEET: M1.1

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.



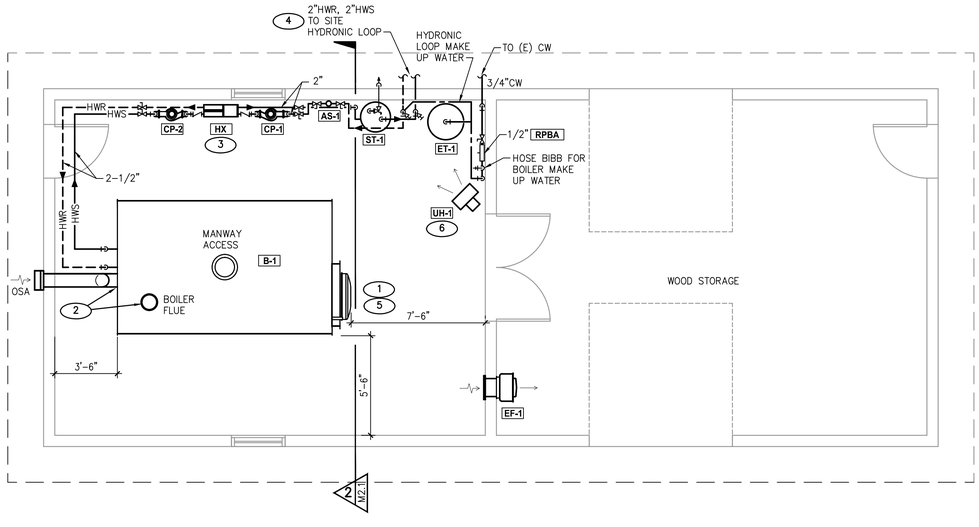
2 EAST ELEVATION
M2.1 SCALE: 1/4" = 1'-0"

KEY NOTES:

1. INSTALL BOILER, PLACE ON FOAM BOARD PER INSTALLATION INSTRUCTIONS FOR BOILER. FOLLOW ALL MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR PLUMBING AND VENTING OF BOILER.
2. CONNECT FLUE AND AIR INLET PER INSTALLATION INSTRUCTIONS USING VERTICAL FLUE MOUNTING AND MANUFACTURER INFORMATION.
3. CONNECT BOILER TO HEAT EXCHANGER AND WATER STORAGE TANK PER AND MANUFACTURER'S INSTRUCTIONS. CHECK ALL CONNECTIONS AND PRESSURE TEST @ 80 PSI BEFORE BACKFILLING.
4. INSTALL "HEAT LOOP" PIPE PER PIPE TRENCHING AND BEDDING SPECS.
5. FOLLOW STARTUP INFORMATION IN BOILER INSTALLATION INSTRUCTIONS AND TEST BOILER.
6. PROVIDE T-STAT CONTROL TO ENABLE UH-1 WHEN TEMPERATURE FALLS BELOW 40° F.

SHEET NOTES:

1. PROVIDE BOILER PER SCHEDULE. INSTALL PER ALL MANUFACTURER'S RECOMENDATIONS.
2. GARN BOILER IS A VENTED, NOT PRESSURIZED, HEATING SYSTEM.



1 BIOMASS HEATING PLANT MECHANICAL PLAN
M2.1 SCALE: 1/4" = 1'-0"

CONSTRUCTION DOCUMENTS

DESIGNED: BEC
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SHEET CONTENTS: BIOMASS HEATING PLANT MECHANICAL PLAN

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: M2.1

DRAWINGS ARE FULL SIZE AT 24X36.
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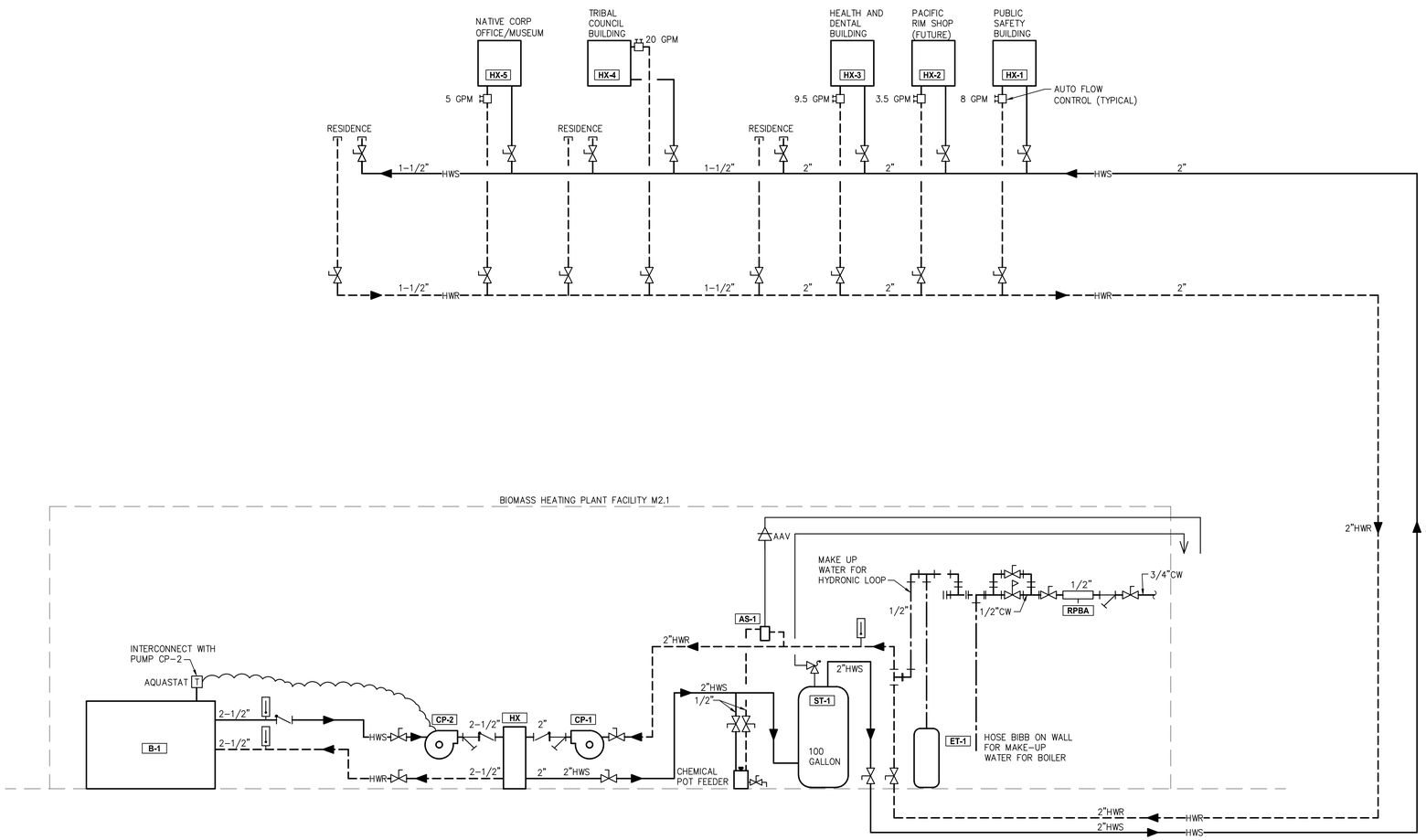
SHEET NOTES:

1. **FILL EXTERIOR HYDRONIC SYSTEM WITH 10% PROPYLENE GLYCOL/WATER SOLUTION.**
2. CHEMICAL TREATMENT FOR BOILER STARTUP WILL BE PROVIDED AFTER TESTING OF FILL WATER SAMPLE PER MANUFACTURER'S RECOMMENDATION.
3. PERIODIC TESTING OF BOILER WATER SHALL BE BI-ANNUALLY PER MANUFACTURER'S RECOMMENDATION BY PRECISION CHEM WATER TREATMENT OF WAUPUN, WI.

SEQUENCE OF OPERATION:

1. PROVIDE AQUASTAT IN BOILER TO TURN ON CP-2 WHILE BOILER TEMPERATURE IS ABOVE 160° F.
2. CP-1 SHALL RUN AT ALL TIMES CP-2 RUNS AND WHEN OUTDOOR TEMPERATURES ARE BELOW 20° F., FOR FREEZE PROTECTION.
3. EXISTING BUILDING HEATING SYSTEMS TO REMAIN IN OPERATION AFTER BIOMASS HEATING PLANT IS CONSTRUCTED. TEMPERATURE SETPOINT FOR EXISTING OIL FIRED BOILERS SHALL BE LOWERED TO 160° F. (ADJUSTABLE) AND ACT AS SECONDARY HEAT SOURCE.



HYDRONIC PIPING DIAGRAM

SCALE: DIAGRAMMATIC

CONSTRUCTION DOCUMENTS

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SHEET CONTENTS: HYDRONIC PIPING DIAGRAM

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: M2.2

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ONE-LINE DIAGRAM

TRANSFORMER, SECONDARY VOLTAGE. PHASE AND RATING INDICATED AS APPLICABLE.

400 — CIRCUIT BREAKER, TRIP SHOWN, 3 POLE UNLESS OTHERWISE NOTED

400 — SWITCH, CURRENT RATING INDICATED, 3 POLE UNLESS OTHERWISE NOTED

CONNECTOR OR DRAWOUT ASSEMBLY

FUSE

POWER

XXX — CONNECTION POINT TO EQUIPMENT SPECIFIED FURNISHED AND INSTALLED UNDER OTHER SECTIONS. RACEWAY, CONDUCTOR AND CONNECTION IN THIS SECTION

CONVENIENCE RECEPTACLE – SINGLE

XXX — CONVENIENCE RECEPTACLE – DUPLEX UNLESS OTHERWISE SPECIFIED (WP=WEATHERPROOF, GFCI=GROUND FAULT INTERRUPTER)

S — COMPUTER ROOM SYSTEM FURNITURE DUPLEX RECEPTACLE

XXX — CONVENIENCE RECEPTACLE – MOUNTED ABOVE COUNTER TOP

XXX — CONVENIENCE RECEPTACLE – FOURPLEX

XXX — CONVENIENCE RECEPTACLE – FOURPLEX – MOUNTED ABOVE COUNTER TOP

CONVENIENCE RECEPTACLE – DUPLEX, MOUNTED FLUSH IN FLOOR

CONVENIENCE RECEPTACLE – FOURPLEX, MOUNTED FLUSH IN

XX — SINGLE PHASE RECEPTACLE, TYPE AS INDICATED OR
A –
B –
C –

XXX — THREE PHASE RECEPTACLE, TYPE AS INDICATED
A –
B –
C –

RACEWAY STUB–UP WITH PEDESTAL FITTING AND WIRING DEVICE AS SHOWN

POKE THRU FITTING WITH FITTING AND WIRING DEVICE AS SHOWN

FLOOR BOX WITH PEDESTAL FITTING AND WIRING DEVICE AS SHOWN

XX XX XX — MULTI OUTLET ASSEMBLY, SEE SPECIFICATIONS

J OR JB — JUNCTION BOX, SIZED PER CODE, NEMA 1, SCREW COVER UNLESS NOTED OTHERWISE.

N — NURSE CALL SWITCH @ 48" TO $\mathcal{L}$

PB — PUSH–BUTTON STATION. NEMA 1 ENCLOSURE UNLESS OTHERWISE INDICATED, (WP=NEMA 4X ENCLOSURE) SEE CONTROL DIAGRAMS OR SCHEDULES FOR TYPE PUSH–BUTTON REQUIRED.

60 — NONFUSED DISCONNECT SWITCH. SIZE INDICATED, 3 POLE UNLESS OTHERWISE INDICATED, NEMA 1 ENCLOSURE, WP= WEATHERPROOF (NEMA 3R)

F 60/40 — FUSED DISCONNECT SWITCH. SIZE INDICATED, (60 = SWITCH RATING, 40 = FUSE RATING) 3 POLE UNLESS OTHERWISE INDICATED, NEMA 1 ENCLOSURE, WP=WEATHERPROOF (NEMA 3R)

XX — CONTACTOR. MAGNETIC, NEMA SIZE INDICATED, NEMA 1 ENCLOSURE UNLESS OTHERWISE INDICATED, SEE CONTROL DIAGRAM

XX — STARTER MAGNETIC NEMA SIZE INDICATED, NEMA 1 ENCLOSURE UNLESS OTHERWISE INDICATED, SEE CONTROL DIAGRAM

XX — COMBINATION (FUSE OR CIRCUIT BREAKER AS INDICATED), MAGNETIC STARTER, NEMA SIZE INDICATED, NEMA 1 ENCLOSURE UNLESS OTHERWISE INDICATED, SEE CONTROL DIAGRAM

XX — ENCLOSED CIRCUIT BREAKER, SIZE AS SHOWN, 3 POLE UNO, NEMA 1 ENCLOSURE UNO.

BRANCH CIRCUIT PANEL BOARD

GROUNDING

GROUND

GROUND ROD

GROUND ROD WITH INSPECTION PIT

G — GROUND BONDING POINT TO STEEL STRUCTURE, REBAR, PIPE, ETC [TYPE AS SHOWN] [SEE DETAILS INDICATED]

G — G — G — GROUNDING CONNECTION (TYP AS SHOWN OR NOTED)

G — BARE COPPER GROUND CONDUCTOR, SIZE AS SHOWN

CONDUIT AND RACEWAY

P2–G23–1 (1,3,5) — HOME RUN, PANEL DESIGNATION SHOWN, CIRCUIT NUMBERS IN PARENTHESIS. SEE PANEL SCHEDULE, ARROW DOES NOT ALWAYS POINT TO PANEL.

CONDUIT AND CONDUCTORS CONCEALED IN CEILINGS AND WALLS *

NOTE* RUNS MARKED WITH CROSSHATCHES INDICATE NUMBER OF NO. 12 THWN WIRES. INCLUDE A NO. 12 GREEN INSULATED GROUND WIRE (NOT SHOWN) IN ALL CONDUITS. THE LONGER CROSSHATCH DENOTES THE NEUTRAL WIRE. SIZE CONDUITS ACCORDING TO SPEC'S AND APPLICABLE CODE. CONDUCTORS OTHER THAN NO. 12 ARE INDICATED BY NOTE. ALL UNMARKED CONDUIT RUNS CONSIST OF 2 NO. 12 THWN CONDUCTORS AND 1 NO. 12 GREEN INSULATED GROUND WIRE.

CONDUIT DOWN

CONDUIT UP

CONDUIT STUBBED AND CAPPED AS SHOWN

CONDUIT SEALOFF FROM HAZARDOUS AREAS

CONDUIT CONTINUED ON REFERENCE DRAWING

XXXX — CIRCUIT DESIGNATION. XXXX REFERS TO CIRCUIT SEE SCHEDULE, THIS SHEET
EXAMPLE: 1254 – CKT TYPE/NO. 1254

LIGHTING

L — LIGHTING CONTACTOR, NEMA 1 ENCLOSURE UNLESS OTHERWISE INDICATED, SEE CONTROL DIAGRAM FOR NUMBER OF POLES AND RATINGS

TC — TIMECLOCK

MS — OCCUPANCY SENSOR

PC — PHOTOCELL LIGHT CONTROLLER

EMERGENCY LIGHTING

ILLUMINATED EXIT SIGN, WITH DIRECTIONAL ARROWS AS INDICATED

COMBO EMERGENCY/EXIT SIGN LIGHTING

WALL MOUNTED LIGHT FIXTURE, SEE SCHEDULE

LIGHT FIXTURES: 3 = CIRCUIT NUMBER WHERE SHOWN
DIAGONAL SLASH = RECESSED
NO SLASH = SURFACE MOUNTED

8'–0" A TYP ROOM — FIXTURE CALLOUT, TYPE F1, NUMBER DENOTES MOUNTING HEIGHT (IN FEET) FOR PENDANT MOUNTED FIXTURES (BTM OF FIXTURE TO FLOOR)

LIGHT FIXTURES WITH STANDBY/EMERGENCY POWER SOURCE

$_{3Pa}$ — WALL SWITCH: 2 – DOUBLE POLE; 3 – THREE WAY; 4 – FOUR WAY; M – MANUAL MOTOR STARTER; L# – LOW VOLTAGE SWITCH; # – SEE LOW VOLTAGE LIGHTING CONTROL SCHEDULE; O – OCCUPANCY SENSOR; P – PILOT LIGHT; K – KEY OPERATOR; D – DIMMER; WP – WEATHERPROOF; T – TIMER; S – SENTRY SWITCH

NOTE: SMALL LETTER SUBSCRIPT ON SWITCH AND LIGHT FIXTURE INDICATES SWITCHING. MULTIPLE SUBSCRIPTS INDICATE MULTIPLE SWITCHES.

FIRE ALARM

F — MANUAL PULL STATION

S — SMOKE DETECTOR, PHOTOELECTRIC

H — THERMAL (HEAT) DETECTOR [R = RATE OF RISE] [F = FIXED]

S — FLAME DETECTOR [I=INFRARED][U=ULTRAVIOLET] DETECTOR

S — SMOKE DETECTOR, DUCT TYPE

FIRE ALARM HORN/STROBE

FIRE ALARM HORN

BELL/GONG

FIRE ALARM STROBE

FIREMAN'S INTERCOM JACK

FS — SPRINKLER WATER, FS=FLOW SWITCH TS=TAMPER SWITCH, PS=PRESSURE SWITCH

FACP — FIRE ALARM CONTROL PANEL

RAP — FIRE ALARM REMOTE ANNUNCIATOR PANEL

R — FIRE ALARM SYSTEM INTERFACE/RELAY, INITIATING OR SIGNAL

DH — COMBINATION DOOR HOLDER/CLOSER

FS — COMBINATION FIRE/SMOKE DAMPER

TELECOMMUNICATIONS

BOX W/ 3/4" MIN PATH TO ABOVE ACCESSIBLE CEILING

CABLE/OUTLET DEVICE REQUIREMENTS

T1 = (1) 4 PR CAT5e CABLE W (1) RJ45 MODULAR JACK
T2 = (1) 4 PR CAT5e CABLE W (2) RJ45 MODULAR JACKS
CONFIRM WITH OWNER AFTER OWNER'S PURCHASE OF TELEPHONE SYSTEM ON SUITABILITY OF USE OF RJ45 VS RJ11 MODULAR JACKS, REVISE TO RJ11 IF REQUESTED BY OWNER.

D1 = (1) 4 PR CAT5e CABLE W (1) RJ45 MODULAR JACK
D2 = (2) 4 PR CAT5e CABLES W (2) RJ45 MODULAR JACKS
D3 = (3) 4 PR CAT5e CABLES W (3) RJ45 MODULAR JACKS
FO = FIBER OPTIC OUTLET (SEE SPECIFICATIONS)
TV = COAXIAL CABLE OUTLET (SEE SPECIFICATIONS)
(1 COAX CABLE W/ MALE FACEPLATE CONNECTOR)

D1 — SAME AS ABOVE, EXCET ABOVE COUNTER

D1 — RECESSED FLOOR BOX/POKE–THRU DEVICE SEE ABOVE FOR CABLE/OUTLET DEVICE REQUIREMENTS

EXTERIOR SYSTEMS

P — PRIMARY SERVICE (OVERHEAD)

S — SECONDARY SERVICE (OVERHEAD)

T — TELEPHONE SERVICE (OVERHEAD)

FA — FIRE ALARM SERVICE (OVERHEAD)

UNDERGROUND CONDUIT/RACEWAY, TYPE AS INDICATED

UNDERGROUND DUCTBANK, TYPE AS INDICATED

MANHOLE SIZE AS SHOWN OR NOTED

HANDHOLE SIZE AS SHOWN OR NOTED

FLOODLIGHT, WALL MOUNTED ARROWS INDICATE AIMING)

FLOODLIGHT, POLE MOUNTED (ARROWS INDICATE AIMING)

AREA/STREET LIGHT FIXTURE, POLE MOUNTED, TYPE AS INDICATED
< DENOTES ORIENTATION OF ASYMMETRICAL DISTRIBUTION

M — ELECTRIC METER

MISCELLANEOUS & INTRUDER DETECTION

BELL/BUZZER (CLASS PROGRAM OR SIMILAR)

HT — HEAT TRACE OUTLET

WALL CLOCK HANGER RECEPTACLE AND CLOCK

CEILING SPEAKER, NUMBER INDICATES ZONE. WHERE NO NUMBER IS SHOWN, ZONE IS SAME AS ROOM NUMBER. (RAULAND NO. ACC 1101/1104 BACKBOX)

WP — WALL SPEAKER, NUMBER INDICATES ZONE. WHERE NO NUMBER IS SHOWN, ZONE IS SAME AS ROOM NUMBER. (RAULAND NO. ACC 1105 BACKBOX) WP= OUTDOOR RATED, RECESSED SPEAKER W/ RAULAND NO. AC1008/ACC1108)

45 OHM SPEAKER, NUMBER INDICATES ZONE. WHERE NO NUMBER IS SHOWN, ZONE IS SAME AS ROOM NUMBER. (RAULAND NO. ACC 110/1104 BACKBOX)

MUSHROOM PUSH BUTTON

INTERCOMM CALL SWITCH (PROVIDE SINGLE GANG DEVICE BOX W/ SINGLE GANG COVER PLATE)

M — MICROPHONE OUTLET JACK, WITH WIRING BACK TO AUDIO RACK (SEE PLAN DWGS)

M — SUSPENDED MICROPHONE (SEE SPECIFICATIONS) PROVIDE OUTLET BOX WITH MICROPHONE CABLE, AND CORD GRIP/STRAIN RELIEF DEVICE AT CEILING

S — SOUND REINFORCEMENT SYSTEM SPEAKER, SEE SPECIFICATIONS.

CCTV SYSTEM CAMERA

A — INTRUDER DETECTION SYSTEM – MOTION AND/OR HEAT SENSOR (SEE SPECIFICATIONS)

K — INTRUDER DETECTION SYSTEM – KEYPAD/ANNUNCIATOR STATION (SEE SPECIFICATIONS)

DRAWING CONVENTIONS

A / E2.2 **SECTION TITLE** SCALE: TO BE DETERMINED — SECTION TITLE UNDERLINE, E2.2 = REFERENCE WHERE SECTION IS TAKEN

1 / E2.2 **DETAIL TITLE** SCALE: TO BE DETERMINED — DETAIL TITLE UNDERLINE, E2.2 = REFERENCE WHERE DETAIL IS TAKEN

1 / E2.2 **ELEVATION TITLE** SCALE: TO BE DETERMINED — ELEVATION TITLE UNDERLINE, E2.2 = REFERENCE WHERE ELEVATION IS TAKEN

N — NORTH ARROW

A / E2.2 — A = SECTION NUMBER, E2.2 = SHEET WHERE SECTION IS DRAWN

1 / E2.2 — 1 = DETAIL NUMBER, E2.2 = SHEET WHERE DETAIL IS DRAWN

1 / E2.2 — 1 = ELEVATION NUMBER, E2.2 = SHEET WHERE ELEVATION IS DRAWN

3 — KEY NOTE

1 — REVISION REFERENCE

GENERAL NOTES

1. THIS IS A GENERAL LEGEND SHEET. NOT ALL SYMBOLS SHOWN ARE CONTAINED IN THE PROJECT DRAWINGS.

ELECTRICAL NOTES

1. ALL AUTOMATIC LIGHTING CONTROLS SHALL BE TESTED AND OR CALIBRATED TO ENSURE COMPLIANCE WITH WASHINGTON STATE ENERGY CODE, SECTION 1513.
2. ALL DEVICES, EQUIPMENT, ENCLOSURES, AND MATERIAL SHALL BE UL LISTED, APPROVED BY THE OWNER REPRESENTATIVE, AND SUITABLE FOR ITS ENVIRONMENT WHERE USED.
3. ALL WORK IS TO BE PERFORMED IN ACCORDANCE WITH NEC AND APPLICABLE LOCAL CODES.
4. THE ELECTRICAL CONTRACTOR IS TO VERIFY ALL EXISTING SITE CONDITIONS AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES, ERRORS OR OMISSIONS IN THE CONTRACT DOCUMENTS, AND SHALL NOT CONTINUE WORK WITHOUT THE ENGINEERS APPROVAL.
5. THESE DRAWINGS ARE DIAGRAMMATIC ONLY, UNLESS SPECIFIC DIMENSIONS AND MOUNTING HEIGHTS ARE GIVEN. VERIFY EXACT LOCATIONS AND MOUNTING HEIGHTS OF ALL LIGHT FIXTURES, SWITCHES AND RECEPTACLES.
6. RACEWAYS AND BOXES ARE SHOWN DIAGRAMMATICALLY ONLY TO INDICATE THE GENERAL AND APPROXIMATE LOCATION. THE LAYOUT DOES NOT SHOW THE TOTAL NUMBER OF RACEWAYS OR BOXES FOR THE CIRCUITS REQUIRED, NOR ARE THE LOCATIONS OF INDICATED RUNS INTENDED TO SHOW THE ACTUAL ROUTING OF THE RACEWAYS.
7. SYSTEM IS TO BE FULLY RATED OR LISTED "SERIES RATED" SUBJECT TO APPROVAL BY THE AHJ.
8. BRANCH CIRCUIT CONDUCTOR SIZES SHALL BE MINIMUM #12 AWG COPPER. MINIMUM CONDUIT SIZE SHALL BE 1/2" FOR BRANCH CIRCUITS, 3/4" FOR HOME RUNS UNLESS OTHERWISE NOTED.
9. INTERIOR RACEWAY/WIRING SHALL UTILIZE THHN COPPER CONDUCTORS AND EMT CONDUIT UNLESS NOTED OTHERWISE.
10. EXTERIOR RACEWAY/WIRING SHALL UTILIZE THWN COPPER CONDUCTORS AND EMT CONDUIT UNLESS NOTED OTHERWISE. CONDUIT AND ASSOCIATED FITTINGS SHALL BE LISTED AND APPROVED FOR CORROSION PROTECTION PER NEC.
11. PROVIDE DEDICATED SAME SIZE NEUTRALS AND INSULATED GROUND WIRES FOR EACH CIRCUIT UNLESS OTHERWISE NOTED.
12. TELE/DATA OUTLET LOCATIONS WHERE SHOWN SHALL CONSIST OF AN APPROPRIATE SIZE BOX WITH RACEWAY PATH TO TELECOM CONNECTION POINT.
13. ALL OCCUPANCY SENSORS ARE TO BE DUAL TECHNOLOGY (ULTRASONIC/PASSIVE INFRARED) TYPE, UNO.
14. AT THE COMPLETION OF THE JOB, ALL EQUIPMENT AND FIXTURES SHALL BE LEFT CLEAN AND IN PROPER CONDITION FOR THEIR INTENDED USE.

ABBREVIATIONS

A	AMPERE, PHASE A	LV	LOW VOLTAGE
A/V	AUDIO VISUAL		
AC	ALTERNATING CURRENT	MAX	MAXIMUM
AFF	ABOVE FINISHED FLOOR	MC	MOMENTARY CONTACT
AFG	ABOVE FINISHED GRADE	MCB	MAIN CIRCUIT BREAKER
AMM	AMMETER	MCC	MOTOR CONTROL CENTER
AMP	AMPERE	MECH	MECHANICAL
APPROX	APPROXIMATELY	MFR	MANUFACTURER
ARCH	ARCHITECT, ARCHITECTURAL	MH	MANHOLE
ATS	AUTOMATIC TRANSFER SWITCH	MLO	MAIN LUGS ONLY
AUX	AUXILIARY	MO	MAGNETIC ONLY (CIRCUIT BREAKER)
AWG	AMERICAN WIRE GAGE	MTD	MOUNTED
		MTG	MOUNTING
B	PHASE B	MTR	MOTOR
BD	BOARD	MTS	MANUAL TRANSFER SWITCH
BKR	BREAKER	MV	MEDIUM VOLTAGE
BLDG	BUILDING		
BTM	BOTTOM	(N)	NEW
		NC	NORMALLY CLOSED
C	CONDUIT, PHASE C	NEC	NATIONAL ELECTRICAL CODE
CB	CIRCUIT BREAKER	NEG	NEGATIVE
CCTV	CLOSED CIRCUIT TELEVISION	NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
CKT	CIRCUIT		
CL	CENTER LINE	NESC	NATIONAL ELECTRICAL SAFETY CODE
CO	CONDUIT ONLY	NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
COAX	COAXIAL	NIC	NOT IN CONTRACT
COL	COLUMN	NM	NON–METALLIC
COND	CONDUCTOR	NO	NORMALLY OPEN
CP	CONTROL PANEL	NOM	NOMINAL
CR	CONTROL RELAY	NREC	NON–RESIDENTIAL CODE
CT	CURRENT TRANSFORMER	NTS	NOT TO SCALE
CTL	CONTROL		
CU	COPPER	OC	ON CENTER
		OD	OUTSIDE DIAMETER
D	DEEP	OL	OVERLOAD
DB	DIRECT BURIAL		
DC	DIRECT CURRENT	P	POLE
DIA	DIAMETER	PA	PUBLIC ADDRESS
DIAG	DIAGONAL	PB	PULLBOX
DISC	DISCONNECT	PC	PHOTOCELL
DIST	DISTRIBUTION	PF	POWER FACTOR
DN	DOWN	PH	PHASE
DS	DISCONNECT SWITCH	PNL	PANEL
DWG	DRAWING	PR	PAIR
		PRI	PRIMARY
(E)	EXISTING	PS	POWER SUPPLY
EA	EACH	PWR	POWER
EF	EXHAUST FAN		
ELEC	ELECTRICAL	QTY	QUANTITY
ELEV	ELEVATOR		
EMER	EMERGENCY	RCPT	RECEPTACLE
ENCL	ENCLOSURE	REF	REFERENCE
EP	EXPLOSION PROOF	RGS	RIGID GALVANIZED STEEL
EQPT	EQUIPMENT	RPM	REVOLUTIONS PER MINUTE
EXH	EXHAUST	RVNR	REDUCED VOLTAGE NONREVERSING
FA	FIRE ALARM	SD	SMOKE DETECTOR
FACP	FIRE ALARM CONTROL PANEL	SEC	SECONDARY
FD	FIRE DAMPER	SHT	SHEET
FDR	FEEDER	SMR	SURFACE METAL RACEWAY
FIC	FURNISHED AND INSTALLED BY CONTRACTOR	SPEC	SPECIFICATION
FIO	FURNISHED AND INSTALLED BY OWNER	SQ	SQUARE
FLA	FULL LOAD AMPERES	STA	STATION
FLR	FLOOR	STP	SHIELDED TWISTED PAIR
FO	FIBER OPTIC	SW	SWITCH
FOIC	FURNISHED BY OWNER INSTALLED BY CONTRACTOR	SWBD	SWITCHBOARD
		SWGR	SWITCHGEAR
FS	FLOW SWITCH	SYM	SYMBOL
FT	FOOT, FEET	SYS	SYSTEM
FVNR	FULL VOLTAGE NONREVERSING		
FVR	FULL VOLTAGE REVERSING	T	TELEPHONE
		TB	TERMINAL BOARD
GEN	GENERATOR	TC	TELECOMMUNICATIONS
GFCI	GROUND FAULT CIRCUIT INTERRUPTER	TECH	TECHNICAL
GFR	GROUND FAULT RELAY	TEMP	TEMPORARY
G, GND	GROUND	TERM	TERMINAL
GSR	GROUND SENSOR RELAY	TM	THERMAL MAGNETIC (CIRCUIT BREAKER)
H		TV	TELEVISION
	HIGH	TW	TWISTED
HH	HANDHOLE	TWP	TWISTED PAIR
HOA	HAND–OFF–AUTOMATIC	TYP	TYPICAL
HP	HORSEPOWER		
HPS	HIGH PRESSURE SODIUM	UC	UNDER COUNTER
HR	HOUR, HOURS	UG	UNDERGROUND
HVAC	HEATING, VENTILATING AND AIR CONDITIONING	UL	UNDERWRITERS LABORATORIES
HW	HOT WATER	UNO	UNLESS NOTED OTHERWISE
HZ	HERTZ (CYCLES PER SECOND)	UTP	UNSHIELDED TWISTED PAIR
IC	INTERRUPTING CAPACITY	V	VOLT
IMC	INTERMEDIATE METAL CONDUIT	VA	VOLT–AMPERE
IN	INCH	VM	VOLTMETER
		VP	VAPOR PROOF
JB	JUNCTION BOX		
		W	WATT
KV	KILOVOLT	W/	WITH
KVA	KILOVOLT AMPERE	W/O	WITHOUT
KVAR	KILOVOLT AMPERE REACTIVE	WG	WIREGUARD
KW	KILOWATT	WH	WATER HEATER
KWD	KILOWATT DEMAND METER	WHD	WATTHOUR DEMAND METER
KWH	KILOWATT HOUR	WHM	WATTHOUR METER
		WP	WEATHERPROOF
LF	LINEAL FOOT		
LTG	LIGHTING	XFMR	TRANSFORMER
LTS	LIGHTS		

OUTLET MOUNTING HEIGHTS

UNLESS INDICATED OTHERWISE ON PLANS AND DETAILS, LOCATE OUTLETS AS FOLLOWS:

RECEPTACLES	+18 INCHES (CENTERLINE)
OUTLETS ABOVE COUNTERS	+6 INCHES (CENTERLINE, ABOVE COUNTER)
CLOCK OUTLETS	+80 INCHES (CENTERLINE)
LIGHT SWITCHES	+48 INCHES (CENTERLINE)
PANELS	+72 INCHES (TOP OF PNL)
VOICE/DATA OUTLETS	+18 INCHES
VOICE OUTLET – WALL	+54 INCHES
MANUAL PULL STATION	+48 INCHES
FIRE ALARM STROBE UNIT	+80 INCHES, BUT NOT CLOSER THAN 6 INCHES FROM CEILING

CONSTRUCTION DOCUMENTS

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SHEET CONTENTS: ELECTRICAL LEGEND

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222

SHEET: E0.1

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

UNIT HEATER SCHEDULE

DESIGNATION	DESCRIPTION	MANUFACTURER	VOLTAGE	WATTS	PHASE
UH-1	SUSPENDED FAN FORCED ELECTRIC UNIT HEATER WITH INTEGRAL THERMOSTAT	BERK0	120	1500	1

NOTES:
1. SET TEMPERATURE ON THERMOSTAT TO RUN HEATER BELOW 40 DEG F. FOR FREEZE PROTECTION.
2. OR EQUAL

LIGHTING FIXTURE SCHEDULE

DESIGNATION	DESCRIPTION	MANUFACTURERS	SERIES	VOLTAGE	WATTS	LAMPS	BALLAST	REMARKS
A	SURFACE MOUNTED 2X4 FLUORESCENT	LITHONIA	L	120	55	(2) T8	ELECTRONIC	COLD START TO 0° F., OR EQUAL.
EXTERIOR LIGHTING								
B	WALL MOUNTED LED FLOOD	MAXLITE	MLSW	120	35	LED	--	WET LISTED, VANDAL RESISTANT. COLD START TO -40° F., W/ FACTORY DUSK-TO-DAWN CONTROL,OR EQUAL.
C	WALL MOUNTED LED FLOOD	MAXLITE	MLSW	120	35	LED	--	WET LISTED, VANDAL RESISTANT. COLD START TO -40° F., OR EQUAL.

PANELBOARD SCHEDULE

PANEL: A
LOCATION: ROOM 1-PHASE
MOUNTING: SURFACE
FED FROM: SOURCE FEED: BTM

VOLTS: 240/120 V BUS RATING: 200 A
MAINS: MLO SC RATING: 35K A
PHASES: 1 AVAIL. FAULT CURRENT: 18K A
WIRES: 3 NO OF POLES:

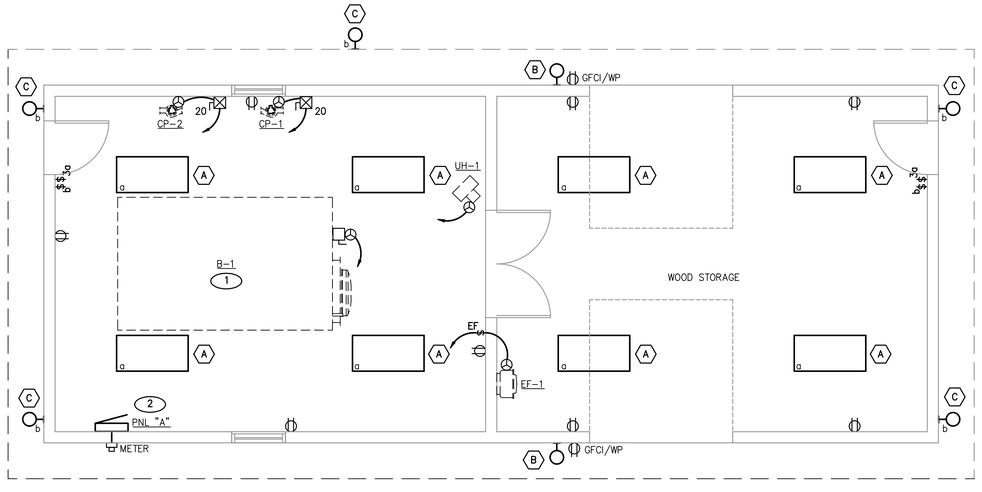
	CIRCUIT DESCRIPTION	LOAD (KVA)	CODE	CB / PH	PHASE	CB / PH	CODE	LOAD (KVA)	CIRCUIT DESCRIPTION	
1	CP1	2.3	LM	20 2P	A	20 1P	S	1.8	BOILER FAN	2
3	"		"	" "	B	20 1P	L	0.6	LIGHTS	4
5	CP2	2.3	OM	20 2P	A	20 1P	RECEPS	0.9	OUTLETS	6
7	"		"	" "	B	20 1P			SPARE	8
9	UNIT HEATER	1.5	H	20 2P	A	20 1P			SPARE	10
11	SPARE			20 1P	B	20 1P			SPARE	12
13	SPARE			20 1P	A	20 1P			SPARE	14
15	SPARE			20 1P	B	20 1P			SPARE	16
17	SPARE			20 1P	A	20 1P			SPARE	18
19	SPARE			20 1P	B	20 1P			SPARE	20
21	SPARE			20 1P	A	20 1P			SPARE	22
23	SPARE			20 1P	B	20 1P			SPARE	24

	CONNECTED			DEMAND
LIGHTING(L)	0.6 Kva	X	100%	0.6 Kva
RECEP < 10 (R)	0.0 Kva	X	100%	0.0 Kva
RECEP > 10 (R,R1)	0.0 Kva	X	50%	0.0 Kva
LARGE MOTOR(LM)	2.3 Kva	X	125%	2.9 Kva
OTHER MOTOR(OM)	2.3 Kva	X	100%	2.3 Kva
HEATING / A.C.(H)	1.5 Kva	X	100%	1.5 Kva
VENTILATION(V)	0.0 Kva	X	100%	0.0 Kva
KITCHEN(K)	0.0 Kva	X	100%	0.0 Kva
DEDICATED(S)	1.8 Kva	X	100%	1.8 Kva

AMPS PER PHASE
PHASE A 47.9
PHASE B: 30.4

SUPPLY VOLTAGE 240/120
CONNECTED LOAD 9.4 Kva
DEMAND LOAD 9.1 Kva
DEMAND AMPS 38 A
DATE REVISED:

Notes:
1.
2.
3.



1 / M2.1 **BIOMASS HEATING PLANT POWER/LIGHTING**
SCALE: 1/4" = 1'-0"

KEY NOTES:

1. COMPLETE ALL ELECTRICAL HOOK UPS PER BOILER INSTALLATION INSTRUCTIONS AND PLAN ELECTRICAL DRAWINGS AND SPECIFICATIONS.
2. PROVIDE 200AMP SINGLE PHASE PANEL. COORDINATE WITH UTILITY FOR METER AND POWER CONNECTION.

SHEET NOTES:

1. CONTRACTOR TO PAY ALL UTILITY AND PERMIT CHARGES.
2. CONTRACTOR TO MAKE ALL NECESSARY ARRANGEMENTS WITH LOCAL ELECTRIC UTILITY.
3. SEE MECHANICAL DRAWING M2.2 FOR PUMP CONTROL, CP-1 AND CP-2.

CONSTRUCTION DOCUMENTS

DESIGNED: GMR
DRAWN: TMP
DATE: 10/23/13

PREPARED BY:

RICHMOND ENGINEERING
8365 Hogum Bay Lane NE
Olympia, WA 98516
TEL (360) 956-0384
FAX (360) 352-1275
RichmondSystems.com

STATE OF ALASKA 49th
George M. Richmond
George M. Richmond
ME 10217
REGISTERED PROFESSIONAL ENGINEER

REVISION	BY	CK'D	DATE
REVIEW COMMENT REVISIONS	TMP	GMR	01/09/14
FINAL DOCUMENTS	TMP	GMR	03/09/15

SHEET CONTENTS: BIOMASS HEATING PLANT POWER/LIGHTING/SCHEDULES

TITLE: CHUGACHMIUT BIOMASS FACILITY
PORT GRAHAM VILLAGE
PORT GRAHAM, AK 99663

PROJECT NO.: 5222
SHEET: E2.1

DRAWINGS ARE FULL SIZE AT 24X36.
SCALE IS INDICATED ON DRAWING.

PORT GRAHAM BIOMASS HEATING PLANT
CONSTRUCTION COST ESTIMATE

CATEGORY MAJOR		REF	QTY		MATERIAL	LABOR	EQUIPMENT	TOTAL	LUMP SUM ADD	SUBTOTAL
SITEWORK										
	LOCATE AND MARK		16	HR		75	50	125		2,000
DIRECT BURIED HYDRONIC PIPING			1470	LF	45			45		66,150
	EXCAVATION		735	LF		2	6	8		5,880
	BEDDING/BACKFILL		735	LF	2.00	2	6	10.00		7,350
	VAULTS		7	EA	250	1200	3	1453		10,171
PUMPS AND VALVES	PUMPS, VALVES, PIPES		4	EA	1000	500		1500		6,000
	PRESURE TANK/AIR SEPERATOR/CHEMICAL FEEDER		1	EA	1000	250		1250		1,250
	HEAT EXCHANGERS		6	EA	1800	500		2300		13,800
BOILER PACKAGE	INCLUDES DELIVERY		1		45000	500	500	46000		46,000
	STACK		15	LF	250	50		300		4,500
POWER										
	SERVICE		1	LS	500	1500		2000		2,000
	BREAKER PANEL		1	LS	500	1000		1500		1,500
	METER BASE		1	LS	500	200		700		700
	BRANCH WIRING		1	LS	1000	1500		2500		2,500
CONTROLS			1	LS	500	1500		2000		2,000
STARTUP/WATER TESTING SUPPORT/TRAINING			20	HR		75		75		1,500

SUB-TOTAL	$173,301		
	$20,796	CONTINGENCY @ 12%	
	$14,000	MOB / DEMOB	
	$5,202	BOND / INSURANCE @ 2.5%	
SUB-TOTAL	$213,300		
	$38,394	O&P	18.00%
SUBTOTAL	**$251,693**		

BOILER BUILDING	INTERIOR		2000	SF	2	2		4		8,000
	EXCAVATE		240	CY	35	0.7	1.06	36.76		8,822
	BACKFILL		240	LF	20	42	0.25	62.25		14,940
	STEM WALL		140	SF	7	20	0.23	27.23		420
	SLAB		1000	SF	7	8		15		15,000
	WALLS		1400	SF	5	8		13		18,200
	ROOF		1200	SF	9.58	17		26.58	550	32,446
BUILDING REPLACEMENT	**$**	**97,828.40**								
GRAND TOTAL	**$**	**349,521.87**								

PROJECT MANUAL

for

PORT GRAHAM BIOMASS FACILITY PROJECT

Port Graham Village Council
Port Graham, AK 99603

PREPARED BY:

Richmond Engineering
8365 Hogum Bay Lane, NE
Olympia, WA 98516
360.956.0384

March 12, 2015

TABLE OF CONTENTS

DIVISION 15 MECHANICAL (continued)

DIVISION 16 ELECTRICAL

END OF TABLE OF CONTENTS

INVITATION TO BID

Notice is hereby given that the Port Graham Village will receive sealed bids until 12:00 p.m., _____, 2015, for the following work:

PORT GRAHAM BIOMASS FACILITY.

Work performed under this contract consists of the following:

Work consists of retrofitting the existing heating systems in each building to utilize hot water provided by the central boiler plant. The existing old pump house will be demolished. A new structure with boiler will be built on the same site.

A mandatory pre-bid conference will be held at the _____ located at _____ on _____, 2015, at 10:00 a.m., local time.

Free-of-charge bid documents (plans, specifications, and addenda) are provided to Prime Bidders. It is the responsibility of the registered bidders to print and distribute bid documents to potential vendors and sub-contractors.

Addendums will be distributed ONLY to registered bidders. The Port Graham Village accepts no responsibility or liability and will provide no accommodation to bidders who fail to check for addendums and/or who do not acknowledge receipt of all addendums in the bid forms.

All Bids must be submitted on the regular bid form furnished within the specifications, and each must be accompanied by a certified check or bidder's bond in an amount not less than five percent (5%) of the total bid.

Should the successful bidder fail to enter into such contract and furnish satisfactory performance bond within the time stated in specifications, the bid proposal deposit shall be forfeited.

The Port Graham Village reserves the right to reject any and all Bids and waive any informality in the bids.

END OF SECTION 00010

SECTION 00100

INSTRUCTIONS TO BIDDERS

PART 1 - GENERAL

1.1 DEFINED TERMS

A. A "*Bidder*" is an entity or person who submits a bid proposal for the work stipulated in the contract documents. The Bidder must be registered by the Washington State Department of Labor and Industries in accordance with RCW 18.27.020. Insert the contractor registration number and federal excise tax number on the Bid Proposal Form in the applicable spaces.

B. The *"Successful Bidder"* is the lowest, responsible and responsive Bidder to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award.

C. *"Addenda"* (Addendum) means the written or graphic instruments issued prior to execution of the Agreement which modifies or interprets the Bidding Documents and Contract Documents.

D. *"Bidding Documents"* include the Invitation to Bid, Instructions to Bidders, Information Available to Bidders, the Bid Form with related documents, the Contract Conditions, Specifications and Drawings (and includes all Addenda issued prior to receipt of Bids).

2.1 MINORITY AND WOMEN'S BUSINESS ENTERPRISE (MWBE) UTILIZATION

A. GENERAL STATEMENT

1. In accordance with the legislative findings and policies set forth in Chapter 39.19 RCW, the State of Washington encourages participation in contracts by MWBE firms certified by the Office of Minority and Women's Business Enterprises (OMWBE). Participation may be either on a direct basis in response to this solicitation/invitation or as a subcontractor to a Bidder. However, unless required by federal statutes, regulations, grants, or contract terms referenced in the contract documents, no preference will be included in the evaluation of bids, no minimum level of MWBE participation shall be required as a condition for receiving an award and bids will not be rejected or considered non-responsive on that basis. Any affirmative action requirements set forth in federal regulations or statutes included or referenced in the contract documents will apply.

B. VOLUNTARY MWBE GOALS

1. The following voluntary numerical MWBE participation goals have been established for this solicitation:

MBE 10% WBE 6%

2. These goals are voluntary, but achievement of the goals is encouraged. Bidders may contact OMWBE at (360) 753-9693 to obtain information on certified firms.

C. REPORTING REQUIREMENTS

1. If any part of the contract, (including the supply of materials and equipment) is subcontracted using certified MWBE firms during completion of the work, then prior to final acceptance or completion of the contract or as otherwise indicated in the contract documents the Bidder shall submit a statement of participation indicating that MWBEs were used and the dollar value of their subcontracts.

2. The provisions of this section are not intended to replace or otherwise change the requirements of RCW 39.30.060. If said statute is applicable to this contract then the failure to comply with RCW 39.30.060 will still render a bid non-responsive.

D. RECORD KEEPING

1. The Bidder shall maintain, for at least three years after completion of this contract, relevant records and information necessary to document the level of utilization of MWBEs and other businesses as subcontractors and suppliers in this contract as well as any efforts the Bidder makes to increase the participation of MWBEs as listed in section 5 below. The Bidder shall also maintain, for at least three years after completion of this contract, a record of all quotes, bids, estimates, or proposals submitted to the Bidder by all businesses seeking to participate as subcontractors or suppliers in this contract. The State shall have the right to inspect and copy such records. If this contract involves federal funds, Bidder shall comply with all record keeping requirements set forth in any Federal rules, regulations, or statutes included or referenced in the contract documents.

E. SUGGESTED EFFORTS TO INCREASE PARTICIPATION BY MWBEs

1. Bidders are encouraged to advertise opportunities for subcontractors or suppliers in a manner reasonably designed to provide MWBEs capable of performing the work with timely notice of such opportunities, and all advertisements shall include a provision encouraging participation by MWBE firms. Advertising may be done through general advertisement (e.g., newspapers, journals, etc.) or by soliciting bids directly from MWBEs.

2. Additional Voluntary Efforts. Bidders are encouraged to:

   a. Break down total requirements into smaller tasks or quantities, where economically feasible, in order to permit maximum participation by MWBEs and other small businesses.
   b. Provide interested MWBEs with adequate and timely information about plans, specifications, and requirements of the Contract.
   c. Establish delivery schedules, where the requirements of this contract permit, that encourage participation by MWBEs and other small businesses.
   d. Reduce bonding requirements where practicable.
   e. Utilize the services of available minority community organizations, minority contractor groups, local minority assistance offices, and organizations that provide assistance in the recruitment and placement of MWBEs and other small businesses.

3. The actions described in this section should supplement efforts to provide information to all qualified firms, and nothing in this section is intended to prevent or discourage the Bidders from inviting proposals for participation from non-MWBE firms as well as

MWBE firms.

F. NON-DISCRIMINATION

1. Bidders shall not create barriers to open and fair opportunities for all businesses including MWBEs to participate in all State contracts and to obtain or compete for contracts and subcontracts as sources of supplies, equipment, construction and services. In considering offers from and doing business with subcontractors and suppliers, the Bidder shall not discriminate on the basis of race, color, creed, religion, sex, age, nationality, marital status, or the presence of any mental or physical disability in an otherwise qualified disabled person.

G. SANCTIONS

1. Any violation of the mandatory requirements of this part of the contract shall be a material breach of contract for which the Bidder may be subject to a requirement of specific performance, or damages and sanctions provided by contract, by RCW 39.19.090, or by other applicable laws.

3.1 COPIES OF BIDDING DOCUMENTS

A. Complete sets of Bidding Documents may be obtained at the location and time indicated in the Invitation to Bid. Complete sets of Bidding Documents must be used in preparing Bids; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents. The Owner and the Engineer in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining bids on Work and do not confer to grant a license for any other use.

4.1 INTERPRETATIONS AND ADDENDA

A. All questions about the meaning or intent of the Bidding Documents are to be directed to the Engineer. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda made available to all parties having received the Bidding Documents, Questions received less than ten days prior to the date for opening of Bids may not be answered. Only questions answered by formal written addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

B. Addenda may also be issued to modify the Bid Documents as deemed advisable by Owner or Engineer.

5.1 EXAMINATION OF SITE AND CONDITION

A. Before submitting a bid, the Bidder shall (a) examine the Bidding Documents thoroughly; (b) visit the site of the work to become familiar with physical conditions which might affect cost, progress, performance or furnishing of the Work; (c) dig test pits or drill test holes to further evaluate subsurface soil conditions to the extent the Bidder considers necessary; (d consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of Work; study and carefully correlate Bidder’s observations with the Contract

Documents; and (f) notify the Engineer of all conflicts, errors or discrepancies in the Contract Documents. Failure to take this precaution will not release the successful Bidder from entering into contracts nor excuse the Bidder from performing the work in strict accordance with the terms of the contract. No statement by any officer, agent, or employee of the Commission pertaining to the physical conditions of the site of the work will be binding on the Commission other than those statements issued in the contract documents.

B. A mandatory pre-bid site visit will be held at 10:00am on the 27th day of March, 2014 starting at the Beacon Hill Water & Sewer District office. Representatives of the Owner and the Engineer will be present to show Bidders the general location of the Work. Bidders are required to visit the site at the time prescribed. The Contractor may arrange with the Owner for access to the site at the Owner's convenience for the purpose of digging test pits or drilling test holes to evaluate subsurface soil conditions. The Contractor shall fill all holes and leave site in "as found condition".

6.1 BID PROPOSAL

A. The Bidder shall submit its bid on the forms included herein. All blank spaces in the Bid Proposal Form shall be properly filled in. If the bid is made by a partnership or co-partnership, it shall be so stated and it shall contain the names of each partner and shall be signed in the firm's name, followed by the written signature of the partners. If the bid is made by a corporation, it shall be signed by the name of the corporation, followed by the written signature of the officer signing, and the printed or typewritten designation of their office within the corporation. The address of the Bidder shall be typed or printed on the bid in the space provided.

B. **Any bid that is expected to cost one million dollars ($1,000,000.00) or more** for the construction, alteration, or repair of any public building or public work of the state shall require each Bidder to submit **as part of the bid** the names of subcontractors with whom the Bidder, if awarded the contract, will subcontract for performance of the work of heating, ventilation and air conditioning, plumbing, and electrical or to name itself for the work. The Bidder shall not list more than one subcontractor for each category of work identified, unless subcontractors vary with bid alternates, in which case the Bidder must indicate which subcontractor will be used for which alternate. **Failure of the Bidder to submit as part of the bid,** the names of such subcontractors, or to name itself to perform such work, or the naming of two or more subcontractors to perform the same work, **shall render the bid as non-responsive**.

C. Except as otherwise provided herein, bid proposals which are incomplete, or which are conditioned in any way, or which contain erasures, alterations, or items not called for in the contract documents, or which do not conform to the call for bids, may be rejected as non-responsive. Only the amounts and information asked for on the Bid Proposal Form and the plans and specifications furnished will be considered as the bid. Bid amounts include all taxes imposed by law, **except** Washington Sales Tax.

D. Each Bidder shall bid upon the work exactly as specified and as provided in the Bid Proposal Form and as clarified above. The Bidder shall bid upon all alternates indicated on the Bid Proposal Form. When bidding on alternates for which there is no charge, the Bidder shall write the words "no charge" in the space provided on the Bid Proposal Form.

E. Bidders shall acknowledge receipt of any addendum to the solicitation for bids by including the signed addendum with the Bid Proposal Form.

7.1 SUBMISSION OF BID

A. Oral, telephone, telegraphic, or facsimile (fax) bids shall not be considered. Any bids received after the scheduled time for receipt of bids shall be returned to the Bidder unopened. Bids shall be enclosed in an opaque sealed envelope, marked with the Project title . The official date and time the bid is received shall be stamped on the bid envelope at the place of the bid opening.

8.1 MODIFICATION OF BID

A. Modification of bids already received will be considered only if the request for the privilege of making such modification is granted by the Owner and the modification is made prior to the scheduled closing time for the receipt of the bids. All modifications must be made in writing over the signature of the Bidder. Facsimile or telegraphic modifications will be accepted only if such modifications are received prior to the bid opening time (telegrams must be delivered) and are confirmed in writing on the stationary of the Bidder. Such confirming letters shall be postmarked by date and time prior to bid opening.

9.1 WITHDRAWAL OF BID

B. At any time prior to the scheduled closing time for receipt of bids, any Bidder may withdraw its bid, either personally, by written request, by facsimile, or by telegraph and confirmed written request.

C. If, within five days after bids are opened, any Bidder files a duly signed, written notice with the Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its bid, how the mistake occurred, that the mistake was not due to an error in judgment or carelessness in inspecting the site or reading the plans or specifications, that the Bidder may withdraw its bid and bid security will be returned. A bidder who wants to withdraw its bid will be disqualified from further bidding on Work to be provided under the Contract Documents.

D. Bids may be withdrawn if bid award is delayed for a period exceeding thirty (30) days.

10.1 REJECTION OF BID

A. The Owner reserves the right to reject any and/or all bids and to waive any and all irregularities in bids not involving price, time or changes in the Work. The owner reserves the right to reject any nonconforming, nonresponsive, incomplete, unbalanced or conditional bids. The owner also reserves the right to reject the bid of any bidder that in the Owner's judgment would not be financially or otherwise responsible or that does not meet pertinent minimum experience criteria established by the Owner and stated in the Instructions to Bidders.

11.1 OPENING OF BIDS

A. Bids will be opened and read publicly at the time and location indicated in the Bid Advertisement.

12.1 BID BOND

A. Each bid must be accompanied by Bid Security conforming to the requirements of Section 00410, Bid Security – Bid Bond.

13.1 BID EVALUATION AND AWARD OF CONTRACT

A. Award of contract will be made by the Owner based upon any combination of the base bid and alternates which, in the Owner's sole discretion, is in the Owner's best interest considering price, schedule and other factors. The numbering of the alternates in the bid proposal bears no relationship to the order in which the alternates may be selected by the Owner. Additionally, the Owner reserves the right to negotiate base bid prices (including changes to the contract plans and specifications) with the low responsive, responsible Bidder to bring the final contract amount within the funds available.

B. The intent of the Owner is to award a contract to the low responsive, responsible bidder by considering the following:

C. Responsibility:

As defined in Chapter 39.04 RCW following the passage of SHB 2010, and including such additional factors, including, but not limited to;

1. The ability, capacity, and skill of the Bidder to perform the work;
2. The character, integrity, reputation, judgment, experience, and efficiency of the Bidder;
3. Whether the Bidder can perform the work within the time specified;
4. The quality of performance of previous work;
5. The previous and existing compliance by the Bidder with laws and requirements relating to the work and contract;
6. Such other information as may have bearing on the decision to award the contract.

D. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to the Owner's satisfaction within the prescribed time.

E. Non-Responsive:

1. Incomplete or non-conforming bid proposal
2. Not registered contractor as required by law
3. No MWBE utilization indicated when required by the invitation to bid
4. No subcontractor's list when required by invitation to bid
5. Submitting a modified bid form

6. Addenda not acknowledged
7. No bid bond when required by invitation to bid
8. No certification when required by invitation to bid

F. If inconsistencies or errors are noted in the bid proposal prices, **prices shown in words shall have precedence over prices shown in figures**. The **unit and lump sum prices shall have precedence over their total amounts**; and the **total amounts shall have precedence over the total bid**.

G. If the contract is to be awarded, Owner will issue to the successful Bidder a Notice of Award within sixty (60) days after the day of the bid opening.

H. In the event of failure of the successful Bidder to sign the Agreement and provide acceptable Performance and Payment Bonds(s), insurance certificates(s), and other required documents, the Owner may award the Contract to the next lowest responsive, responsible Bidder.

14.1 BID RESULTS

A. Bidders may obtain bid results by telephone at (360) 956-0384.

15.1 INSURANCE

A. The Owner's requirements for insurance are set forth in Part 2 of the General Conditions.

16.1 SIGNING OF AGREEMENT

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement, with all other written Contract Documents attached. Within fifteen days thereafter the Contractor shall sign and deliver the required number of counterparts of the Agreement together with the required Bonds to the Owner. Within ten days thereafter the Owner will deliver one fully signed counterpart to the Contractor.

17.1 SALES TAX

A. Retail sales tax to be collected from the Owner on the Contract Price shall be stated separately in the spaces provided, as applicable, and shall not be included in the amount Bid for Lump Sum Work or Unit Price Work stated in the Bid. The amount of retail sales tax stated will not be considered as a competitive bid item and will not be included in determining the Successful Bidder and will be considered to be an estimate only.

B. All other federal, state and local sales, use or other taxes as required by federal, state or local laws shall be included in the amount Bid for Lump Sum Work or Unit Price Work, or other prices stated in the bid.

18.1 DOCUMENTS THAT MUST BE SUBMITTED WITH BIDS

Bidders must submit the following signed Documents with their Bids:

Document Number	Title
00300	Bid Form
00410	Bid Security
00416	Bidder's References
00420	Bidder's Qualifications

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 00100

Project Name: Port Graham Biomass Facility **Project No.:**

Agency: Port Graham Village

B I D P R O P O S A L

In compliance with the contract documents, the following bid proposal is submitted:

1) BASE BID

_____ $_____

(Please print dollar amount in space above) **(do not include State Sales Tax)**

---

2) BID ALTERNATES *(Specify whether additive or deductive)*

(1) _____ $_____

(2) _____ $_____

(3) _____ $_____

(4) _____ $_____

(5) _____ $_____

(6) _____ $_____

Do not include State Sales Tax **in alternate amounts**.

The Owner reserves the right to accept or reject any or all bid prices within sixty (60) days of the bid date.

Time for Completion

The undersigned hereby agrees to complete all the work under the Base Bid (and accepted alternates) within 180 calendar days after the date of Notice to Proceed.

Project Name: Port Graham Biomass Facility **Project No.:**

Agency: Port Graham Village

UNIT PRICES *(Where applicable) (Do not include State Sales Tax)*

Item No.	Unit Description	Estimated Quantities	Additive Unit Price	Deductive Unit Price	Per Measurement
1.			$	$	
2.			$	$	
3.			$	$	
4.			$	$	
5.			$	$	

The above unit prices shall be for any additive and deductive work within 15% of the above estimated quantities. The unit price shall include full compensation for the cost of labor, materials, equipment, overhead, profit and any additional costs associated with the unit bid.

The Owner reserves the right to accept or reject any or all unit prices within sixty (60) days of the bid date.

Subcontractor Listing – RCW 39.30.060

If the base bid and the sum of the additive alternates is one million dollars or more the bidder shall provide names of the subcontractors with whom the bidder will **directly** subcontract for performance of the following work. If the bidder intends to perform the work, the bidder must enter its name for that category of work.

The bidder shall not list more than one subcontractor for each category of work identified UNLESS subcontractors vary with bid alternates, in which case the bidder must indicate which subcontractor will be used for which alternate.

Failure of the bidder to submit the NAMES of such subcontractors or to name itself to perform such work shall render the bidder's bid nonresponsive and, therefore, void.

	Designated Work	Firm Name
1.	Site Work	_____
2.	Mechanical	_____
3.	Electrical	_____
4.	Controls	_____

Bidder may attach a separate sheet for additional alternate bid subcontractors.

Apprenticeship Requirements

The apprentice labor hours required for this project are 0% of the total labor hours. The undersigned agrees to utilize this level of apprentice participation.

Project Name: Port Graham Biomass Facility **Project No.:**

Agency: Port Graham Village

Liquidated Damages

The undersigned agrees to pay the Owner as liquidated damages the sum of $500.00 for each consecutive calendar day that is in default after the Contract Time. Liquidated damages shall be deducted from the contract by change order.

Receipt of Addenda

Receipt of the following addenda is acknowledged:

Addendum No. _____	Addendum No. _____
Addendum No. _____	Addendum No. _____
Addendum No. _____	Addendum No. _____

Name of Firm _____

NOTE: *If bidder is a corporation, write State of Incorporation; if a partnership, give full names and addresses of all parties below.*

Signed by _____, Official Capacity _____

Print Name _____

Address _____

City _____ State _____ Zip Code _____

Date _____ Telephone _____ FAX _____

State of Washington Contractor's License No. _____

Federal Tax ID # _____ e-mail address: _____

Employment Security Department No. _____

END OF SECTION 00300

DOCUMENT NUMBER 00410

BID SECURITY

1. Bid Security, made payable to the Port Graham Village, shall accompany each Bid. Bid Security shall be in the form of a cashier's check or certified check in the amount of not less than five percent (5%) of the Bidder's maximum price, or in the form of a Bid Bond in said amount (in the form attached). Bid Bond shall be executed by such sureties as are named in the current list of "Certified Companies Holding Certificates of Authority As Acceptable Sureties on Federal Bonds or Certified Reinsurer Companies Holding Certificates Of Authority As Acceptable Reinsuring Companies" published in Circular 570 (most recent amendment) by the Audit Staff Bureau of Accounts, U.S. Treasury Department (www.fms.treas.gov/c570/index.html) and is admitted to issue bonds in the states in which the Project is located and all Work is performed. All Bonds signed by an agent shall be accompanied by a certified copy of the authority to act.

2. Bid Security shall remain subject to acceptance for sixty (60) days after the day of the Bid opening, but the Owner may, at its sole discretion, release any Bid and return the Bid Security prior to that date.

3. The Bid Security of the successful Bidder will be retained until such Bidder has within fifteen (15) days of issuance of written notice of contract award:

   A. Executed the contract agreement,

   B. Furnished a performance bond and a payment bond fully executed as described in the Contract Forms section.

   C. Furnished certificates of insurance as described in the General Conditions, and

   If the successful Bidder fails to deliver the executed documents described above within fifteen days after Notice of Award, the Owner may annul the Notice of Award and the Bid Security of that Bidder will be forfeited.

4 The Bid Security of other Bidders whom the Owner believes to have a reasonable chance of receiving the award may be retained by the Owner until the earlier of the seventh day after the effective date of the Agreement or the sixty-first day after the Bid opening, whereupon Bid Security furnished by such Bidders will be returned.

5. Bid Security with Bids which are not competitive will be returned within seven days after the Bid.

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned,

_____

As Principal, and

_____

As Surety, are hereby held and firmly bound unto

_____as Owner in the penal sum of

_____

dollars for the payment of which sum, well and truly to be made, we hereby bind ourselves, our successors and assigns jointly and severally firmly by these presents.

Signed and sealed, this _____day of_____, 20_____

The Condition of the above obligation is such that where the Principal has submitted a certain Bid, attached hereto and hereby made a part hereof to enter into a contract in writing, for construction of

_____Project.

NOW, THEREFORE;

A. If said Bid shall be rejected, or

B. If said Bid shall be accepted and the Principal shall execute and deliver a contract in the Form of the Agreement attachment hereto (properly completed in accordance with said Bid) and shall furnish Bonds for Faithful Performance of said contract, and for the Payment of all persons performing labor and furnishing material in connection therewith, and provide certificates and policies of insurance as specified in the Bid documents and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation of this obligation as herein stated.

   The surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and presents to be signed by their duly authorized officers, the day and year first set forth above.

_____(Seal)
Principal

_____

By:_____

END OF SECTION 00410

BIDDER'S REFERENCES
(To be submitted with Bid)

Reference is hereby made to the following bank or banks about the financial responsibility of the Bidder:

Name of Bank	Address
_____	_____
	_____
_____	_____
	_____

Reference is hereby made to the following surety company or companies about the financial responsibility and general reliability of the Bidder:

Name of Surety Company _____

_____

_____

Name of Surety Company _____

_____

_____

Signature of Bidder _____

Title _____

Company _____

Address _____

_____

END OF SECTION 00416

BIDDER'S QUALIFICATIONS
(To be submitted with Bid)

The Bidder has been engaged in the contracting business, under the present business name for _____ years. Experience in work of a nature similar to that covered in the proposal extends over a period of _____years.

The Bidder, as a contractor, has never failed to satisfactorily complete a contract awarded to him, except as follows:

_____

_____

_____

The following contracts have been satisfactorily completed in the last three years for the person, firm or authority indicated, and to whom reference is made:

Year	Type of Work	Contract Amount	For Whom

Signed: _____

(Same signature as on bid form)

END OF SECTION 00420

NOTICE OF AWARD

Dated: _____

TO: _____
(BIDDER)

ADDRESS: _____

_____

_____

PROJECT: _____

OWNERS'S CONTRACT NO: _____

You are notified that your Bid dated _____ for the above Contract has been considered. You are the apparent Successful Bidder and have been awarded a contract for

_____

_____
(Indicate total Work, alternates or sections of work awarded)

The Contract Price of your contract is _____

_____Dollars ($_____)

Four (4) copies of each of the proposed Contract Documents (including four (4) half-size sets of Drawings) accompany this Notice of Award.

You must comply with the following conditions precedent within *fifteen (15)* days of the date of this Notice of Award, that is by _____, 2014.

1. You must deliver to the Owner **three (3)** fully executed counterparts of the Agreement including all the Contract Documents.
2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Instructions to Bidders, General Conditions and Supplementary Conditions.

END OF SECTION 00510

NOTICE TO PROCEED

Dated: _____

TO: _____
(BIDDER)

ADDRESS: _____

_____

_____

PROJECT: _____

OWNERS'S CONTRACT NO: _____

You are notified that the Contract Times under the above contract will commence to run on _____, 20_____. By that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 2 of the Agreement the date of Substantial Completion for all Work is _____.

Before you may start any Work at the site, Part 2, Section 2.03 of the General Conditions provides that you must deliver to the Owner a certificate of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Also before you may start any Work at the site, you must:

_____
(add any other requirements)

_____
(OWNER)

By: _____
(AUTHORIZED SIGNATURE)

_____
(TITLE)

ACCEPTANCE OF CONTRACT TIMES

_____
(OWNER)

By: _____
(AUTHORIZED SIGNATURE)

_____
(TITLE)

_____
(DATE)

END OF SECTION 00520

DECLARATION OF OPTION FOR
MANAGEMENT OF STATUTORY RETAINED PERCENTAGE

1. DESCRIPTION

Do not execute the Declaration of Option for Management of Statutory Retained Percentage as part of the bid submission.

2. DECLARATION OF OPTION FOR MANAGEMENT OF STATUTORY RETAINED PERCENTAGE.

A. I hereby elect to have the retained percentage of this Contract held in a fund by Beacon Hill Water and Sewer District until final acceptance of the Work and all required releases are obtained.

Signed_____

Date_____

B. I hereby elect to have Beacon Hill Water and Sewer District hereinafter called "Owner," invest the retained percentage of this Contract from time to time as such retained percentage accrues in accordance with RCW 60.28.010, .020, and .050.

I hereby designate _____
as the repository for the escrow of said funds.

I hereby further agree to be fully responsible for payment of all costs or fees incurred as a result of placing said retained percentage in escrow and investing it as authorized by statute. The Owner shall not be liable in any way for any costs or fees in connection therewith.

Signed_____

Date_____

END OF SECTION 00590

DOCUMENT NUMBER 00610

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That, WHEREAS, Port Graham Village, hereinafter designated as the "Owner" on _____, 20_____, has awarded to _____ _____ hereinafter designated as the "Principal", a Contract for construction of _____ _____, the terms and provisions of which Contract are incorporated herein by reference, and:

WHEREAS, said Principal is required under the terms of said Contract to furnish a bond for the faithful performance of said Contract;

NOW, THEREFORE, WE, THE Principal, and _____ _____ as Surety, are held and firmly bound unto the Owner, in the penal sum of _____ Dollars, ($ _____), lawful money of the United States, being one hundred percent (100%) of the Contract amount for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the above bounden Principal, his or its heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and faithfully perform the covenants, conditions, and agreements in the said Contract and any alterations made as therein provided, on his or their part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the Owner, its officers and agents, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

As a condition precedent to the satisfactory completion of the said Contract, the above obligation shall hold good for a period of two (2) years after the completion and acceptance of the said work, during which time if the above bounden Principal, his or its heirs, executors, administrators, successors or assigns shall fail to make full, complete and satisfactory repair and replacements or totally protect the Owner from loss or damage made evident during said period of two (2) years from the date of acceptance of said work, and resulting from or caused by defective materials or faulty workmanship in the prosecution of the work done, the above obligation shall remain in full force and virtue; otherwise the above obligation shall be void.

And the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or the Specification accompanying the same shall in any way affect its obligations on this bond; and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract, or to the work, or to the Specification.

In the event of the Owner or its successors or assigns, shall be the prevailing party in an action brought upon this bond, then in addition to the penal sum hereinabove specified, we agree to pay the Owner, or its successors or assigns, all of its reasonable attorney's fees, costs and expenses incurred, which sum shall be fixed by the court.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their seals this _____ day of _____, 20 _____, the name and corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____

_____

_____
Principal

_____

_____

_____
Attorney-in-Fact, Surety

_____
Name and Address
Local Office of Agent

APPROVED:

PORT GRAHAM VILLAGE_____

STATE OF ALASKA_____

By:_____

Date:_____

END OF SECTION 00610

GENERAL CONDITIONS FOR PORT GRAHAM VILLAGE CONSTRUCTION

PART 1 - GENERAL PROVISIONS

1.01 DEFINITIONS

A. "Application for Payment" means a written request submitted by Contractor to A/E for payment of Work completed in accordance with the Contract Documents and approved Schedule of Values, supported by such substantiating data as Owner or A/E may require.

B. "Architect," "Engineer," or "A/E" means a person or entity lawfully entitled to practice architecture or engineering, representing Owner within the limits of its delegated authority.

C. "Change Order" means a written instrument signed by Owner and Contractor stating their agreement upon all of the following: (1) a change in the Work; (2) the amount of the adjustment in the Contract Sum, if any, and (3) the extent of the adjustment in the Contract Time, if any.

D. "Claim" means Contractor's exclusive remedy for resolving disputes with Owner regarding the terms of a Change Order or a request for equitable adjustment, as more fully set forth in part 8.

E. “Contract Award Amount” is the sum of the Base Bid and any accepted Alternates.

F. "Contract Documents" means the Advertisement for Bids, Instructions for Bidders, completed Form of Proposal, General Conditions, Modifications to the General Conditions, Supplemental Conditions, Public Works Contract, other Special Forms, Drawings and Specifications, and all addenda and modifications thereof.

G. "Contract Sum" is the total amount payable by Owner to Contractor for performance of the Work in accordance with the Contract Documents.

H. "Contract Time" is the number of calendar days allotted in the Contract Documents for achieving Substantial Completion of the Work.

I. "Contractor" means the person or entity who has agreed with Owner to perform the Work in accordance with the Contract Documents.

J. "Drawings" are the graphic and pictorial portions of the Contract Documents showing the design, location, and dimensions of the Work, and may include plans, elevations, sections, details, schedules, and diagrams.

K. "Final Acceptance" means the written acceptance issued to Contractor by Owner after Contractor has completed the requirements of the Contract Documents.

L. "Final Completion" means that the Work is fully and finally completed in accordance with the Contract Documents.

M. "Force Majeure" means those acts entitling Contractor to request an equitable adjustment in the Contract Time, as more fully set forth in paragraph 3.05A.

N. "Notice" means a written notice which has been delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended or, if delivered or sent by registered or certified mail, to the last business address known to the party giving notice.

O. "Notice to Proceed" means a notice from Owner to Contractor that defines the date on which the Contract Time begins to run.

P. "Owner" means the state agency, institution, or its authorized representative with the authority to enter into, administer, and/or terminate the Work in accordance with the Contract Documents and make related determinations and findings.

Q. "Person" means a corporation, partnership, business association of any kind, trust, company, or individual.

R. "Prior Occupancy" means Owner's use of all or parts of the Project before Substantial Completion.

S. "Progress Schedule" means a schedule of the Work, in a form satisfactory to Owner, as further set forth in section 3.02.

T. "Project" means the total construction of which the Work performed in accordance with the Contract Documents may be the whole or a part and which may include construction by Owner or by separate contractors.

U. "Project Manual" means the volume usually assembled for the Work which may include the bidding requirements, sample forms, and other Contract Documents.

V. "Project Record" means the separate set of Drawings and Specifications as further set forth in paragraph 4.02A.

W. "Schedule of Values" means a written breakdown allocating the total Contract Sum to each principle category of Work, in such detail as requested by Owner.

X. "Specifications" are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.

Y. "Subcontract" means a contract entered into by Subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind for or in connection with the Work.

Z. "Subcontractor" means any person, other than Contractor, who agrees to furnish or furnishes any supplies, materials, equipment, or services of any kind in connection with the Work.

AA. "Substantial Completion" means that stage in the progress of the Work where Owner has full and unrestricted use and benefit of the facilities for the purposes intended, as more fully set forth in section 6.07.

AB. "Work" means the construction and services required by the Contract Documents, and includes, but is not limited to, labor, materials, supplies, equipment, services, permits, and the manufacture and fabrication of components, performed, furnished, or provided in accordance with the Contract Documents.

1.02 ORDER OF PRECEDENCE

Any conflict or inconsistency in the Contract Documents shall be resolved by giving the documents precedence in the following order.

1. Signed Public Works Contract, including any Change Orders, and any Special Forms.

2. Supplemental Conditions.

3. Modifications to the General Conditions.

4. General Conditions.

5. Specifications--provisions in Division 1 shall take precedence over provisions of any other Division.

6. Drawings, stated dimensions take precedent over scaled dimensions;

7. Large scale drawings shall take precedence over small scale drawings;

8. Detailed drawings take precedence over general or typical drawings;

9. Specific notes on drawings take precedence over schedules; and

10. Notes, descriptions and schedules take precedence over graphic representations on drawings.

1.03 EXECUTION AND INTENT

Contractor makes the following representations to Owner:

1. The Contract Sum is reasonable compensation for the Work and the Contract Time is adequate for the performance of the Work, as represented by the Contract Documents;

2. Contractor has carefully reviewed the Contract Documents, visited and examined the Project site, become familiar with the local conditions in which the Work is to be performed, and satisfied itself as to the nature, location, character, quality and quantity of the Work, the labor, materials, equipment, goods, supplies, work, services and other items to be furnished and all other requirements of the Contract Documents, as well as the surface and subsurface conditions and other matters that may be encountered at the Project site or affect performance of the Work or the cost or difficulty thereof;

3. Contractor is financially solvent, able to pay its debts as they mature, and possesses sufficient working capital to complete the Work and perform Contractor's obligations required by the Contract Documents; and

4. Contractor is able to furnish the plant, tools, materials, supplies, equipment and labor required to complete the Work and perform the obligations required by the Contract Documents and has sufficient experience and competence to do so.

PART 2 - INSURANCE AND BONDS

2.01 CONTRACTOR'S LIABILITY INSURANCE

Prior to commencement of the Work, Contractor shall obtain all the insurance required by the Contract Documents and provide evidence satisfactory to Owner that such insurance has been procured. Review of the Contractor's insurance by Owner shall not relieve or decrease the liability of Contractor. Companies writing the insurance to be obtained by this part shall be licensed to do business under Chapter 48 RCW or comply with the Surplus Lines Law of the State of Washington. Contractor shall include in its bid the cost of all insurance and bond costs required to complete the base bid work and accepted alternates. Insurance carriers providing insurance in accordance with the Contract Documents shall be acceptable to Owner, and its A.B. Best rating shall be indicated on the insurance certificates.

A. Contractor shall at its sole cost, obtain and maintain, in force and effect for duration the Work and for one year after Final Acceptance, Commercial General Liability Insurance policies with a company or companies with a Best’s rating of of "A VII" or better, and who are approved by the Insurance Commissioner of the State of Washington pursuant to Title 48 RCW. The Contractor shall require compliance with these Insurance Requirements by its lower tier subcontractors:

B. Prior to the execution of the Contract, the Contractor shall purchase a Comprehensive General Liability insurance policy meeting the requirements set forth herein. The Contractor shall file with the District either a certified copy of all policies with endorsements attached, or a certificate of insurance (ACCORD form) with endorsements attached as are necessary to comply with these specifications. Failure of the Contractor to fully comply with the requirements regarding insurance will be considered a material breach of the Contract and shall be cause for immediate termination of the Contract and of any and all District obligations, regarding same.

C. The Contractor shall not begin work under the Contract or under any special condition until all required insurance has been obtained and until such insurance has been approved by the District. Said insurance shall provide coverage to the Contractor, subcontractors and District. The coverage so provided shall protect against claims from bodily injuries,

including accidental death, as well as claims for property damages which may arise from any act or omission of the Contractor, his subcontractors, or by anyone directly or indirectly employed by either of them.

D. The insurance policies shall specifically name the District, its elected or appointed officers, officials, employees and volunteers as insureds with regards to damages and defense of claims arising from: (a) activities performed by or on behalf of the contractor; or (b) products and completed operation of the Contractor, or (c) premises owned, leased or used by the Contractor. The insurance shall be maintained in full force and effect at the Contractor's expense throughout the term of the contract.

E. The District shall be given at least 45 days written notice of cancellation, nonrenewal, material reduction or modification of coverage. Such notice to shall be by "certified mail" to the District.

F. The coverages provided by the Contractor's insurance policies are to be primary to any insurance maintained by the District, except as respects losses attributable to the sole negligence of the District. Any insurances that might cover this Contract which are maintained by the District shall be in excess of the Contractor's insurance and shall not contribute with the Contractor's insurances.

G. The Contractor's insurance policies shall protect each insured in the same manner as though a separate policy had been issued to each. The inclusion of more than one Insured shall not affect the rights of any Insured as respects any claim, suit or judgement made or brought by or for any other Insured or by or for any employee of any other Insured. However this provision shall not increase the limits of the insurer's liability.

H. The General Aggregate provision of the Contractor's insurance policies shall be amended to show that the General Aggregate Limit of the policies apply separately to this project.

I. The Contractor's insurance policies shall not contain deductibles or self-insured retentions in excess of $10,000 unless approved by the District.

J. The Contractor's insurance policies shall contain a provision that the District has no obligation to report events which might give rise to a claim until a claim has been filed with the District's Board of Commissioners.

K. Types and Limits of Insurance Required:

1. Commercial General Liability
    a. $2,000,000 per occurrence liability(Including bodily injury)

2. Property Damage liability
    a. $2,000,000 annual aggregate
    b. Employees and volunteers as Additional Insureds
    c. Premises and operations
    d. Broad form property damage including underground, explosion and collapse hazards (XCU) if applicable
    e. Products completed operations (through guaranty period)
    f. Blanket contractual
    g. Subcontractors
    h. Personal injury with employee exclusion deleted
    i. Employers liability (Stop Gap)

3. Automobile Liability
    a. $1,000,000 per accident Bodily Injury and Property
    b. Damage Liability including:
        i. Any owned automobile
        ii. Hired automobiles
        iii. Non owned automobile

4. Umbrella Liability
    a. $2,000,000 per occurrence
    b. $2,000,000 aggregate

L. As an alternative to the above indicated Commercial General Liability and Umbrella Liability insurance policies the Contractor may provide the District with an Owners and Contractors Protective (OCP) policy with a limit of coverage of $5,000,000. If the Contractor provides an OCP policy, the contractor shall additionally provide the District with evidence that the Contractor's Commercial General Liability policy has been endorsed adding the District, its elected and appointed officials, officers, employees, agents and volunteers as Insureds for at least products completed operations coverage.

M. Providing of coverages in the stated amounts shall not be construed to relieve the Contractor from liability in excess of such limits.

N. The Contractor shall maintain Worker's Compensation Insurance and\or Longshore and Harbor Workers Insurance as required by State or Federal statute, for all of his employees to be engaged in work on the Project under this contract and, in case any such work is sublet, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance and\or Longshore and Harbor Worker's Insurance for all of the latter's employee's engaged in such work. The Contractor's Labor & Industries account number shall be noted on the Certificate of Insurance.

O. In the event any class of employees engaged in the work under this Contract is not covered under Worker's Compensation insurance or Longshore and Harbor Worker's insurance as required by State and Federal statute, the Contractor shall maintain and cause each subcontractor to maintain Employer's Liability Insurance for limits of at least $1,000,000 each employee for disease or accident, and shall furnish the Owner with satisfactory evidence of such.

P. The Contractor shall be solely and completely responsible for safety and safety conditions on the job site, including the safety of all persons and property during performance of the work. The services of the District's or engineer's personnel in conducting construction review of the Contractor's performance is not to include review of the adequacy of the Contractor's work methods, equipment, bracing, scaffolding, or trenching, or safety measures in, on, or near the construction site. The Contractor shall provide safe access for the Owner and its inspectors to adequately inspect the quality of work and the conformance with project specifications.

Q. The Contractor shall be solely and completely responsible to perform all work and furnish all materials in strict compliance with all applicable state, city, county and federal laws, regulations, ordinances, orders and codes. The contractor's attention is directed to the requirements of the Washington Industrial Safety and Health Act, (WISHA), RCW 49.17.

R. The District will not pay any progress payments until the Contractor has fully complied with this section. This remedy is not exclusive and the District may take such other action as is available under other provisions of this contract, or otherwise in law.

S. The contractual coverage of the Contractor's policy shall be sufficiently broad enough to insure the provisions of the HOLD HARMLESS AND INDEMNIFICATION AGREEMENT of this contract.

T. Nothing contained in these insurance requirements is to be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from his operations under this contract.

2.02 PAYMENT AND PERFORMANCE BONDS

Payment and performance bonds for 100% of the Contract Sum, including all Change Orders and state sales tax, shall be furnished for the Work, and shall be in a form acceptable to the Owner. No payment or performance bond is required if the Contract Sum is $25,000 or less and Contractor agrees that Owner may, in lieu of the bond, retain 50% of the Contract Sum for the period allowed by RCW 39.08.010.

2.03 ADDITIONAL BOND SECURITY

Contractor shall promptly furnish additional security required to protect Owner and persons supplying labor or materials required by the Contract Documents if:

A. Owner has a reasonable objection to the surety; or

B. Any surety fails to furnish reports on its financial condition if requested by Owner.

2.04 BUILDER'S RISK

A. Contractor shall purchase and maintain property insurance in the amount of the Contract Sum including all Change Orders for the Work on a replacement cost basis until Substantial Completion. The insurance shall cover the interest of Owner, Contractor, and any Subcontractors, as their interests may appear.

B. Contractor property insurance shall be placed on an "all risk" basis and insure against the perils of fire and extended coverage and physical loss or damage including theft, vandalism, malicious mischief, collapse, false work, temporary buildings, debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for A/E's services and expenses required as a result of an insured loss.

C. Owner and Contractor waive all subrogation rights against each other, any Subcontractors, A/E, A/E's subconsultants, separate contractors described in section 5.20, if any, and any of their subcontractors, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this section or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by Owner as fiduciary. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

PART 3 - TIME AND SCHEDULE

3.01 PROGRESS AND COMPLETION

Contractor shall diligently prosecute the Work, with adequate forces, achieve Substantial Completion within the Contract Time, and achieve Final Completion within a reasonable period thereafter.

3.02 CONSTRUCTION SCHEDULE

A. Unless otherwise provided in Division 1, Contractor shall, within 14 days after issuance of the Notice to Proceed, submit a preliminary Progress Schedule. The Progress Schedule shall show the sequence in which Contractor proposes to perform the Work, and the dates on which Contractor plans to start and finish major portions of the Work, including dates for shop drawings and other submittals, and for acquiring materials and equipment.

B. Unless otherwise provided in Division 1,
The Progress Schedule shall be in the form of a bar chart, or a critical path method analysis, as specified by Owner. The preliminary Progress Schedule may be general, showing the major portions of the Work, with a more detailed Progress Schedule submitted as directed by Owner.

C. Owner shall return comments on the preliminary Progress Schedule to Contractor within 14 days of receipt. Review by Owner of Contractor's schedule does not constitute an approval or acceptance of Contractor's construction means, methods, or sequencing, or its ability to complete the Work within the Contract Time. Contractor shall revise and resubmit its schedule, as necessary. Owner may withhold a portion of progress payments until a Progress Schedule has been submitted which meets the requirements of this section.

D. Contractor shall utilize and comply with the Progress Schedule. On a monthly basis, or as otherwise directed by Owner, Contractor shall submit an updated Progress Schedule at its own expense to Owner indicating actual progress. If, in the opinion of Owner, Contractor is not in conformance with the Progress Schedule for reasons other than acts of Force Majeure as identified in section 3.05, Contractor shall take such steps as are necessary to bring the actual completion dates of its work activities into conformance with the Progress Schedule, or revise the Progress Schedule to reconcile with the actual progress of the Work.

E. Contractor shall promptly notify Owner in writing of any actual or anticipated event which is delaying or could delay achievement of any milestone or performance of any critical path activity of the Work. Contractor shall indicate the expected duration of the delay, the anticipated effect of the delay on the Progress Schedule, and the action being or to be taken to correct the problem. Provision of such notice does not relieve Contractor of its obligation to complete the Work within the Contract Time.

3.03 OWNER'S RIGHT TO SUSPEND THE WORK FOR CONVENIENCE

A. Owner may, at its sole discretion, order Contractor, in writing, to suspend all or any part of the Work for up to 90 days, or for such longer period as mutually agreed.

B. Upon receipt of a written notice suspending the Work, Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of cost of performance directly attributable to such suspension. Within a period up to 90 days after the notice is delivered to Contractor, or within any extension of that period to which the parties shall have agreed, Owner shall either:

1. Cancel the written notice suspending the Work; or

2. Terminate the Work covered by the notice as provided in the termination provisions of part 9.

C. If a written notice suspending the Work is cancelled or the period of the notice or any extension thereof expires, Contractor shall resume Work.

D. Contractor shall be entitled to an equitable adjustment in the Contract Time, or Contract

Sum, or both, for increases in the time or cost of performance directly attributable to such suspension, provided Contractor complies with all requirements set forth in part 7.

3.04 OWNER'S RIGHT TO STOP THE WORK FOR CAUSE

A. If Contractor fails or refuses to perform its obligations in accordance with the Contract Documents, Owner may order Contractor, in writing, to stop the Work, or any portion thereof, until satisfactory corrective action has been taken.

B. Contractor shall not be entitled to an equitable adjustment in the Contract Time or Contract Sum for any increased cost or time of performance attributable to Contractor's failure or refusal to perform or from any reasonable remedial action taken by Owner based upon such failure.

3.05 DELAY

A. Any delay in or failure of performance by Owner or Contractor, other than the payment of money, shall not constitute a default hereunder if and to the extent the cause for such delay or failure of performance was unforeseeable and beyond the control of the party ("Force Majeure"). Acts of Force Majeure include, but are not limited to:

1. Acts of God or the public enemy;

2. Acts or omissions of any government entity;

3. Fire or other casualty for which Contractor is not responsible;

4. Quarantine or epidemic;

5. Strike or defensive lockout;

6. Unusually severe weather conditions which could not have been reasonably anticipated; and

7. Unusual delay in receipt of supplies or products which were ordered and expedited and for which no substitute reasonably acceptable to Owner was available.

B. Contractor shall be entitled to an equitable adjustment in the Contract Time for changes in the time of performance directly attributable to an act of Force Majeure, provided it makes a request for equitable adjustment according to section 7.03. Contractor shall not be entitled to an adjustment in the Contract Sum resulting from an act of Force Majeure.

C. Contractor shall be entitled to an equitable adjustment in Contract Time, and may be entitled to an equitable adjustment in Contract Sum, if the cost or time of Contractor's performance is changed due to the fault or negligence of Owner, provided the Contractor makes a request according to sections 7.02 and 7.03.

D. Contractor shall not be entitled to an adjustment in Contract Time or in the Contract Sum for any delay or failure of performance to the extent such delay or failure was caused by Contractor or anyone for whose acts Contractor is responsible.

E. To the extent any delay or failure of performance was concurrently caused by the Owner and Contractor, Contractor shall be entitled to an adjustment in the Contract Time for that portion of the delay or failure of performance that was concurrently caused, provided it makes a request for equitable adjustment according to section 7.03, but shall not be entitled to an adjustment in Contract Sum.

F. Contractor shall make all reasonable efforts to prevent and mitigate the effects of any delay, whether occasioned by an act of Force Majeure or otherwise.

3.06 NOTICE TO OWNER OF LABOR DISPUTES

A. If Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay timely performance in accordance with the Contract Documents, Contractor shall immediately give notice, including all relevant information, to Owner.

B. Contractor agrees to insert a provision in its Subcontracts and to require insertion in all sub-subcontracts, that in the event timely performance of any such contract is delayed or threatened by delay by any actual or potential labor dispute, the Subcontractor or Sub-subcontractor shall immediately notify the next higher tier Subcontractor or Contractor, as the case may be, of all relevant information concerning the dispute.

3.07 DAMAGES FOR FAILURE TO ACHIEVE TIMELY COMPLETION

A. Liquidated Damages

1. Timely performance and completion of the Work is essential to Owner and time limits stated in the Contract Documents are of the essence. Owner will incur serious and substantial damages if Substantial Completion of the Work does not occur within the Contract Time. However, it would be difficult if not impossible to determine the exact amount of such damages. Consequently, provisions for liquidated damages are included in the Contract Documents.

2. The liquidated damage amounts set forth in the Contract Documents will be assessed not as a penalty, but as liquidated damages for breach of the Contract Documents. This amount is fixed and agreed upon by and between the Contractor and Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain. This amount shall be construed as the actual amount of damages sustained by the Owner, and may be retained by the Owner and deducted from periodic payments to the Contractor.

3. Assessment of liquidated damages shall not release Contractor from any further obligations or liabilities pursuant to the Contract Documents.

B. Actual Damages

Actual damages will be assessed for failure to achieve Final Completion within the time provided. Actual damages will be calculated on the basis of direct architectural, administrative, and other related costs attributable to the Project from the date when Final Completion should have been achieved, based on the date Substantial Completion is actually achieved, to the date Final Completion is actually achieved. Owner may offset these costs against any payment due Contractor.

PART 4 - SPECIFICATIONS, DRAWINGS, AND OTHER DOCUMENTS

4.01 DISCREPANCIES AND CONTRACT DOCUMENT REVIEW

A. The intent of the Specifications and Drawings is to describe a complete Project to be constructed in accordance with the Contract Documents. Contractor shall furnish all labor, materials, equipment, tools, transportation, permits, and supplies, and perform the Work required in accordance with the Drawings, Specifications, and other provisions of the Contract Documents.

B. The Contract Documents are complementary. What is required by one part of the Contract Documents shall be binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, shall be of like effect as if shown or mentioned in both.

C. Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by Owner. If, during the performance of the Work, Contractor finds a conflict, error, inconsistency, or omission in the Contract Documents, it shall promptly and before proceeding with the Work affected thereby, report such conflict, error, inconsistency, or omission to A/E in writing.

D. Contractor shall do no Work without applicable Drawings, Specifications, or written modifications, or Shop Drawings where required, unless instructed to do so in writing by Owner. If Contractor performs any construction activity, and it knows or reasonably should have known that any of the Contract Documents contain a conflict, error, inconsistency, or omission, Contractor shall be responsible for the performance and shall bear the cost for its correction.

E. Contractor shall provide any work or materials the provision of which is clearly implied and is within the scope of the Contract Documents even if the Contract Documents do not mention them specifically.

F. Questions regarding interpretation of the requirements of the Contract Documents shall be referred to the A/E.

4.02 PROJECT RECORD

A. Contractor shall legibly mark in ink on a separate set of the Drawings and Specifications all actual construction, including depths of foundations, horizontal and vertical locations of internal and underground utilities and appurtenances referenced to permanent visible and accessible surface improvements, field changes of dimensions and details, actual suppliers, manufacturers and trade names, models of installed equipment, and Change Order proposals. This separate set of Drawings and Specifications shall be the "Project Record."

B. The Project Record shall be maintained on the project site throughout the construction and shall be clearly labeled "PROJECT RECORD". The Project Record shall be updated at least weekly noting all changes and shall be available to Owner at all times.

C. Contractor shall submit the completed and finalized Project Record to A/E prior to Final Acceptance.

4.03 SHOP DRAWINGS

A. "Shop Drawings" means documents and other information required to be submitted to A/E by Contractor pursuant to the Contract Documents, showing in detail: the proposed fabrication and assembly of structural elements; and the installation (i.e. form, fit, and attachment details) of materials and equipment. Shop Drawings include, but are not limited to, drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, samples, and similar materials furnished by Contractor to explain in detail specific portions of the Work required by the Contract Documents. For materials and equipment to be incorporated into the Work, Contractor submittal shall include the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the item. When directed, Contractor shall submit all samples at its own expense. Owner may duplicate, use, and disclose Shop Drawings provided in accordance with the Contract Documents.

B. Contractor shall coordinate all Shop Drawings, and review them for accuracy, completeness, and compliance with the Contract Documents and shall indicate its approval thereon as evidence of such coordination and review. Where required by law, Shop Drawings shall be stamped by an appropriate professional licensed by the state of Washington. Shop Drawings submitted to A/E without evidence of Contractor's approval shall be returned for resubmission. Contractor shall review, approve, and submit Shop Drawings with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of Owner or separate contractors. Contractor's submittal schedule shall allow a reasonable time for A/E review. A/E will review, approve, or take other appropriate action on the Shop Drawings. Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings until the respective submittal has been reviewed and the A/E has approved or taken other appropriate action. Owner and A/E shall respond to Shop Drawing submittals with reasonable promptness. Any Work by Contractor shall be in accordance with reviewed Shop Drawings. Submittals made by Contractor which are not required by the Contract Documents may be returned without action.

C. Approval, or other appropriate action with regard to Shop Drawings, by Owner or A/E shall not relieve Contractor of responsibility for any errors or omissions in such Shop Drawings, nor from responsibility for compliance with the requirements of the Contract Documents. Unless specified in the Contract Documents, review by Owner or A/E shall not constitute an approval of the safety precautions employed by Contractor during construction, or constitute an approval of Contractor's means or methods of construction. If Contractor fails to obtain approval before installation, and the item or work is subsequently rejected, Contractor shall be responsible for all costs of correction.

D. If Shop Drawings show variations from the requirements of the Contract Documents, Contractor shall describe such variations in writing, separate from the Shop Drawings, at the time it submits the Shop Drawings containing such variations. If A/E approves any such variation, an appropriate Change Order will be issued. If the variation is minor and does not involve an adjustment in the Contract Sum or Contract Time, a Change Order need not be issued; however, the modification shall be recorded upon the Project Record.

E. Unless otherwise provided in Division I, Contractor shall submit to A/E for approval 5 copies of all Shop Drawings. Unless otherwise indicated, 3 sets of all Shop Drawings shall be retained by A/E and 2 sets shall be returned to Contractor.

4.04 ORGANIZATION OF SPECIFICATIONS

Specifications are prepared in sections which conform generally with trade practices. These sections are for Owner and Contractor convenience and shall not control Contractor in dividing the Work among the Subcontractors or in establishing the extent of the Work to be performed by any trade.

4.05 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER DOCUMENTS

A. The Drawings, Specifications, and other documents prepared by A/E are instruments of A/E's service through which the Work to be executed by Contractor is described. Neither Contractor nor any Subcontractor shall own or claim a copyright in the Drawings, Specifications, and other documents prepared by A/E, and A/E shall be deemed the author of them and will, along with any rights of Owner, retain all common law, statutory, and other reserved rights, in addition to the copyright. All copies of these documents, except Contractor's set, shall be returned or suitably accounted for to A/E, on request, upon completion of the Work.

B. The Drawings, Specifications, and other documents prepared by the A/E, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner and A/E. Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by A/E appropriate to and for use in the execution of their Work.

C. Contractor and all Subcontractors grant a non-exclusive license to Owner, without additional cost or royalty, to use for its own purposes (including reproduction) all Shop Drawings, together with the information and diagrams contained therein, prepared by Contractor or any Subcontractor. In providing Shop Drawings, Contractor and all Subcontractors warrant that they have authority to grant to Owner a license to use the Shop Drawings, and that such license is not in violation of any copyright or other intellectual property right. Contractor agrees to defend and indemnify Owner pursuant to the indemnity provisions in section 5.23 from any violations of copyright or other intellectual property rights arising out of Owner's use of the Shop Drawings hereunder, or to secure for Owner, at Contractor's own cost, licenses in conformity with this section.

D. The Shop Drawings and other submittals prepared by Contractor, Subcontractors of any tier, or its or their equipment or material suppliers, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor of any tier, or material or equipment supplier, on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner. The Contractor, Subcontractors of any tier, and material or equipment suppliers are granted a limited license to use and reproduce applicable portions of the Shop Drawings and other submittals appropriate to and for use in the execution of their Work under the Contract Documents.

PART 5 - PERFORMANCE

5.01 CONTRACTOR CONTROL AND SUPERVISION

A. Contractor shall supervise and direct the Work, using its best skill and attention, and shall perform the Work in a skillful manner. Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, unless the Contract Documents give other specific instructions concerning these matters. Contractor shall disclose its means and methods of construction when requested by Owner.

B. Performance of the Work shall be directly supervised by a competent superintendent who is satisfactory to Owner and has authority to act for Contractor. The superintendent shall not be changed without the prior written consent of Owner.

C. Contractor shall be responsible to Owner for acts and omissions of Contractor, Subcontractors, and their employees and agents.

D. Contractor shall enforce strict discipline and good order among Contractor's employees and other persons performing the Work. Contractor shall not permit employment of persons not skilled in tasks assigned to them. Contractor's employees shall at all times conduct business in a manner which assures fair, equal, and nondiscriminatory treatment of

all persons. Owner may, by written notice, request Contractor to remove from the Work or Project site any employee Owner reasonably deems incompetent, careless, or otherwise objectionable.

E. Contractor shall keep on the Project site a copy of the Drawings, Specifications, addenda, reviewed Shop Drawings, and permits and permit drawings.

F. Contractor shall ensure that its owner(s) and employees, and those of its Subcontractors, comply with the Ethics in Public Service Act RCW 42.52, which, among other things, prohibits state employees from having an economic interest in any public works contract that was made by, or supervised by, that employee. Contractor shall remove, at its sole cost and expense, any of its, or its Subcontractors', employees, if they are in violation of this act.

5.02 PERMITS, FEES, AND NOTICES

A. Unless otherwise provided in the Contract Documents, Contractor shall pay for and obtain all permits, licenses, and inspections necessary for proper execution and completion of the Work. Prior to Final Acceptance, the approved, signed permits shall be delivered to Owner.

B. If allowances for permits or utility fees are called for in the Contract Documents and set forth in Contractor's bid, and the actual costs of those permits or fees differ from the allowances in the Contract Documents, the difference shall be adjusted by Change Order.

C. Contractor shall comply with and give notices required by all federal, state, and local laws, ordinances, rules, regulations, and lawful orders of public authorities applicable to performance of the Work.

5.03 PATENTS AND ROYALTIES

Contractor is responsible for, and shall pay, all royalties and license fees. Contractor shall defend, indemnify, and hold Owner harmless from any costs, expenses, and liabilities arising out of the infringement by Contractor of any patent, copyright, or other intellectual property right used in the Work; however, provided that Contractor gives prompt notice, Contractor shall not be responsible for such defense or indemnity when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents. If Contractor has reason to believe that use of the required design, process, or product constitutes an infringement of a patent or copyright, it shall promptly notify Owner of such potential infringement.

5.04 PREVAILING WAGES

A. Contractor shall pay the prevailing rate of wages to all workers, laborers, or mechanics employed in the performance of any part of the Work in accordance with RCW 39.12 and the rules and regulations of the Department of Labor and Industries. The schedule of prevailing wage rates for the locality or localities of the Work, is determined by the Industrial Statistician of the Department of Labor and Industries. It is the Contractor’s responsibility to verify the applicable prevailing wage rate.

B. Before commencing the Work, Contractor shall file a statement under oath with Owner and with the Director of Labor and Industries certifying the rate of hourly wage paid and to be paid each classification of laborers, workers, or mechanics employed upon the Work by Contractor and Subcontractors. Such rates of hourly wage shall not be less than the prevailing wage rate.

C. Disputes regarding prevailing wage rates shall be referred for arbitration to the Director of the Department of Labor and Industries. The arbitration decision shall be final and conclusive and binding on all parties involved in the dispute as provided for by RCW 39.12.060.

D. Each Application for Payment submitted by Contractor shall state that prevailing wages have been paid in accordance with the prefiled statement(s) of intent, as approved. Copies of the approved intent statement(s) shall be posted on the job site with the address and telephone number of the Industrial Statistician of the Department of Labor and Industries where a complaint or inquiry concerning prevailing wages may be made.

E. In compliance with chapter 296-127 WAC, Contractor shall pay to the Department of Labor and Industries the currently established fee(s) for each statement of intent and/or affidavit of wages paid submitted to the Department of Labor and Industries for certification.

5.05 HOURS OF LABOR

A. Contractor shall comply with all applicable provisions of RCW 49.28 and they are incorporated herein by reference. Pursuant to that statute, no laborer, worker, or mechanic employed by Contractor, any Subcontractor, or any other person performing or contracting to do the whole or any part of the Work, shall be permitted or required to work more than eight hours in any one calendar day, provided, that in cases of extraordinary emergency, such as danger to life or property, the hours of work may be extended, but in such cases the rate of pay for time employed in excess of eight hours of each calendar day shall be not less than one and one-half times the rate allowed for this same amount of time during eight hours' service.

B. Notwithstanding the preceding paragraph, RCW 49.28 permits a contractor or subcontractor in any public works contract subject to those provisions, to enter into an agreement with its employees in which the employees work up to ten hours in a calendar day. No such agreement may provide that the employees work ten-hour days for more than four calendar days a week. Any such agreement is subject to approval by the employees. The overtime provisions of RCW 49.28 shall not apply to the hours, up to forty hours per week, worked pursuant to any such agreement.

5.06 NONDISCRIMINATION

A. Discrimination in all phases of employment is prohibited by, among other laws and regulations, Title VII of the Civil Rights Act of 1964, the Vietnam Era Veterans Readjustment Act of 1974, sections 503 and 504 of the Vocational Rehabilitation Act of 1973, the Equal Employment Act of 1972, the Age Discrimination Act of 1967, the Americans with Disabilities Act of 1990, the Civil Rights Act of 1991, Presidential Executive Order 11246, Executive Order 11375, the Washington State Law Against Discrimination, RCW 49.60, and Gubernatorial Executive Order 85-09. These laws and regulations establish minimum requirements for affirmative action and fair employment practices which Contractor must meet.

B. During performance of the Work:

1. Contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability, Vietnam era veteran status, or disabled veteran status, nor commit any other unfair practices as defined in RCW 49.60.

2. Contractor shall, in all solicitations or advertisements for employees placed by or for it, state that all qualified applicants will be considered for employment, without regard to race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability.

3. Contractor shall send to each labor union, employment agency, or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice advising the labor union, employment agency, or workers' representative of Contractor's obligations according to the Contract Documents and RCW 49.60.

4. Contractor shall permit access to its books, records, and accounts, and to its premises by Owner, and by the Washington State Human Rights Commission, for the purpose of investigation to ascertain compliance with this section of the Contract Documents.

5. Contractor shall include the provisions of this section in every Subcontract.

5.07 SAFETY PRECAUTIONS

A. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Work.

B. In carrying out its responsibilities according to the Contract Documents, Contractor shall protect the lives and health of employees performing the Work and other persons who may be affected by the Work; prevent damage to materials, supplies, and equipment whether on site or stored off-site; and prevent damage to other property at the site or adjacent thereto. Contractor shall comply with all applicable laws, ordinances, rules, regulations, and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss; shall erect and maintain all necessary safeguards for such safety and protection; and shall notify owners of adjacent property and utilities when prosecution of the Work may affect them.

C. Contractor shall maintain an accurate record of exposure data on all incidents relating to the Work resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment. Contractor shall immediately report any such incident to Owner. Owner shall, at all times, have a right of access to all records of exposure.

D. Contractor shall provide all persons working on the Project site with information and training on hazardous chemicals in their work at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

1. Information. At a minimum, Contractor shall inform persons working on the Project site of:

   a. The requirements of chapter 296-62 WAC, General Occupational Health Standards;

   b. Any operations in their work area where hazardous chemicals are present; and

   c. The location and availability of written hazard communication programs, including the required list(s) of hazardous chemicals and material safety data sheets required by chapter 296-62 WAC.

2. Training. At a minimum, Contractor shall provide training for persons working on the Project site which includes:

   a. Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

   b. The physical and health hazards of the chemicals in the work area;

   c. The measures such persons can take to protect themselves from these hazards, including specific procedures Contractor, or its Subcontractors, or others have implemented to protect those on the Project site from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and

   d. The details of the hazard communications program developed by Contractor, or its Subcontractors, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

E. Contractor's responsibility for hazardous, toxic, or harmful substances shall include the following duties:

1. Contractor shall not keep, use, dispose, transport, generate, or sell on or about the Project site, any substances now or hereafter designated as, or which are subject to regulation as, hazardous, toxic, dangerous, or harmful by any federal, state or local law, regulation, statute or ordinance (hereinafter collectively referred to as "hazardous substances", in violation of any such law, regulation, statute, or ordinance, but in no case shall any such hazardous substance be stored more than 90 days on the Project site.

2. Contractor shall promptly notify Owner of all spills or releases of any hazardous substances which are otherwise required to be reported to any regulatory agency and pay the cost of cleanup. Contractor shall promptly notify Owner of all failures to comply with any federal, state, or local law, regulation, or ordinance; all inspections of the Project site by any regulatory entity concerning the same; all regulatory orders or fines; and all responses or

interim cleanup actions taken by or proposed to be taken by any government entity or private party on the Project site.

F. All Work shall be performed with due regard for the safety of the public. Contractor shall perform the Work so as to cause a minimum of interruption of vehicular traffic or inconvenience to pedestrians. All arrangements to care for such traffic shall be Contractor's responsibilities. All expenses involved in the maintenance of traffic by way of detours shall be borne by Contractor.

G. In an emergency affecting the safety of life or the Work or of adjoining property, Contractor is permitted to act, at its discretion, to prevent such threatened loss or injury, and Contractor shall so act if so authorized or instructed.

H. Nothing provided in this section shall be construed as imposing any duty upon Owner or A/E with regard to, or as constituting any express or implied assumption of control or responsibility over, Project site safety, or over any other safety conditions relating to employees or agents of Contractor or any of its Subcontractors, or the public.

5.08 OPERATIONS, MATERIAL HANDLING, AND STORAGE AREAS

A. Contractor shall confine all operations, including storage of materials, to Owner-approved areas.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be provided by Contractor only with the consent of Owner and without expense to Owner. The temporary buildings and utilities shall remain the property of Contractor and shall be removed by Contractor at its expense upon completion of the Work.

C. Contractor shall use only established roadways or temporary roadways authorized by Owner. When materials are transported in prosecuting the Work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by federal, state, or local law or regulation.

D. Ownership and control of all materials or facility components to be demolished or removed from the Project site by Contractor shall immediately vest in Contractor upon severance of the component from the facility or severance of the material from the Project site. Contractor shall be responsible for compliance with all laws governing the storage and ultimate disposal. Contractor shall provide Owner with a copy of all manifests and receipts evidencing proper disposal when required by Owner or applicable law.

E. Contractor shall be responsible for the proper care and protection of its materials and equipment delivered to the Project site. Materials and equipment may be stored on the premises subject to approval of Owner. When Contractor uses any portion of the Project site as a shop, Contractor shall be responsible for any repairs, patching, or cleaning arising from such use.

F. Contractor shall protect and be responsible for any damage or loss to the Work, or to the materials or equipment until the date of Substantial Completion, and shall repair or replace without cost to Owner any damage or loss that may occur, except damages or loss caused by the acts or omissions of Owner. Contractor shall also protect and be responsible for any damage or loss to the Work, or to the materials or equipment, after the date of Substantial Completion, and shall repair or replace without cost to Owner any such damage or loss that might occur, to the extent such damages or loss are caused by the acts or omissions of Contractor, or any Subcontractor.

5.09 PRIOR NOTICE OF EXCAVATION

A. "Excavation" means an operation in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means, except the tilling of soil less than 12 inches in depth for agricultural purposes, or road ditch maintenance that does not change the original road grade or ditch flow line. Before commencing any excavation, Contractor shall provide notice of the scheduled commencement of excavation to all owners of underground facilities or utilities, through locator services.

5.10 UNFORESEEN PHYSICAL CONDITIONS

A. If Contractor encounters conditions at the site which are subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then Contractor shall give written notice to Owner promptly and in no event later than 7 days after the first observance of the conditions. Conditions shall not be disturbed prior to such notice.

B. If such conditions differ materially and cause a change in Contractor's cost of, or time required for, performance of any part of the Work, the Contractor may be entitled to an equitable adjustment in the Contract Time or Contract Sum, or both, provided it makes a request therefor as provided in part 7.

5.11 PROTECTION OF EXISTING STRUCTURES, EQUIPMENT, VEGETATION, UTILITIES, AND IMPROVEMENTS

A. Contractor shall protect from damage all existing structures, equipment, improvements, utilities, and vegetation: at or near the Project site; and on adjacent property of a third party, the locations of which are made known to or should be known by Contractor. Contractor shall repair any damage, including that to the property of a third party, resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, Owner may have the necessary work performed and charge the cost to Contractor.

B. Contractor shall only remove trees when specifically authorized to do so, and shall protect vegetation that will remain in place.

5.12 LAYOUT OF WORK

A. Contractor shall plan and lay out the Work in advance of operations so as to coordinate all work without delay or revision.

B. Contractor shall lay out the Work from Owner-established baselines and bench marks indicated on the Drawings, and shall be responsible for all field measurements in connection with the layout. Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the Work. Contractor shall be responsible for executing the Work to the lines and grades that may be established. Contractor shall be responsible for maintaining or restoring all stakes and other marks established.

5.13 MATERIAL AND EQUIPMENT

A. All equipment, material, and articles incorporated into the Work shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in the Contract Documents. References in the Specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard quality and shall not be construed as limiting competition. Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of A/E, is equal to that named in the specifications, unless otherwise specifically provided in the Contract Documents.

B. Contractor shall do all cutting, fitting, or patching that may be required to make its several parts fit together properly, or receive or be received by work of others set forth in, or reasonably implied by, the Contract Documents. Contractor shall not endanger any work by cutting, excavating, or otherwise altering the Work and shall not cut or alter the work of any other contractor unless approved in advance by Owner.

C. Should any of the Work be found defective, or in any way not in accordance with the Contract Documents, this work, in whatever stage of completion, may be rejected by Owner.

5.14 AVAILABILITY AND USE OF UTILITY SERVICES

A. Owner shall make all reasonable utilities available to Contractor from existing outlets and supplies, as specified in the Contract Documents. Unless otherwise provided in the Contract Documents, the utility service consumed shall be charged to or paid for by Contractor at prevailing rates charged to Owner or, where the utility is produced by Owner, at reasonable rates determined by Owner. Contractor will carefully conserve any utilities furnished.

B. Contractor shall, at its expense and in a skillful manner satisfactory to Owner, install and maintain all necessary temporary connections and distribution lines, together with appropriate protective devices, and all meters required to measure the amount of each utility used for the purpose of determining charges. Prior to the date of Final Acceptance, Contractor shall remove all temporary connections, distribution lines, meters, and associated equipment and materials.

5.15 TESTS AND INSPECTION

A. Contractor shall maintain an adequate testing and inspection program and perform such tests and inspections as are necessary or required to ensure that the Work conforms to the requirements of the Contract Documents. Contractor shall be responsible for inspection and quality surveillance of all its Work and all Work performed by any Subcontractor. Unless otherwise provided, Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. Contractor shall give Owner timely notice of when and where tests and inspections are to be made. Contractor shall maintain complete inspection records and make them available to Owner.

B. Owner may, at any reasonable time, conduct such inspections and tests as it deems necessary to ensure that the Work is in accordance with the Contract Documents. Owner shall promptly notify Contractor if an inspection or test reveals that the Work is not in accordance with the Contract Documents. Unless the subject items are expressly accepted by Owner, such Owner inspection and tests are for the sole benefit of Owner and do not:

1. Constitute or imply acceptance;

2. Relieve Contractor of responsibility for providing adequate quality control measures;

3. Relieve Contractor of responsibility for risk of loss or damage to the Work, materials, or equipment;

4. Relieve Contractor of its responsibility to comply with the requirements of the Contract Documents; or

5. Impair Owner's right to reject defective or nonconforming items, or to avail itself of any other remedy to which it may be entitled.

C. Neither observations by an inspector retained by Owner, the presence or absence of such inspector on the site, nor inspections, tests, or approvals by others, shall relieve Contractor from any requirement of the Contract Documents, nor is any such inspector authorized to change any term or condition of the Contract Documents.

D. Contractor shall promptly furnish, without additional charge, all facilities, labor, material and equipment reasonably needed for performing such safe and convenient inspections and tests as may be required by Owner. Owner may charge Contractor any additional cost of inspection or testing when Work is not ready at the time specified by Contractor for inspection or testing, or when prior rejection makes reinspection or retest necessary. Owner shall perform its inspections and tests in a manner that will cause no undue delay in the Work.

5.16 CORRECTION OF NONCONFORMING WORK

A. If a portion of the Work is covered contrary to the requirements in the Contract Documents, it must, if required in writing by Owner, be uncovered for Owner's observation and be replaced at the Contractor's expense and without change in the Contract Time.

B. If, at any time prior to Final Completion, Owner desires to examine the Work, or any portion of it, which has been covered, Owner may request to see such Work and it shall be uncovered by Contractor. If such Work is in accordance

with the Contract Documents, the Contractor shall be entitled to an adjustment in the Contract Sum for the costs of uncovering and replacement, and, if completion of the Work is thereby delayed, an adjustment in the Contract Time, provided it makes a request therefor as provided in part 7. If such Work is not in accordance with the Contract Documents, the Contractor shall pay the costs of examination and reconstruction.

C. Contractor shall promptly correct Work found by Owner not to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed, or completed. Contractor shall bear all costs of correcting such nonconforming Work, including additional testing and inspections.

D. If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or within one year after the date for commencement of any system warranties established under section 6.08, or within the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, Contractor shall correct it promptly after receipt of written notice from Owner to do so. Owner shall give such notice promptly after discovery of the condition. This period of one year shall be extended, with respect to portions of Work first performed after Substantial Completion, by the period of time between Substantial Completion and the actual performance of the Work. Contractor's duty to correct with respect to Work repaired or replaced shall run for one year from the date of repair or replacement. Obligations under this paragraph shall survive Final Acceptance.

E. Contractor shall remove from the Project site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by Contractor nor accepted by Owner.

F. If Contractor fails to correct nonconforming Work within a reasonable time after written notice to do so, Owner may replace, correct, or remove the nonconforming Work and charge the cost thereof to the Contractor.

G. Contractor shall bear the cost of correcting destroyed or damaged Work, whether completed or partially completed, caused by Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

H. Nothing contained in this section shall be construed to establish a period of limitation with respect to other obligations which Contractor might have according to the Contract Documents. Establishment of the time period of one year as described in paragraph 5.16D relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the Contractor's obligation to comply with the Contract Documents may be sought to be enforced, including the time within which such proceedings may be commenced.

I. If Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, Owner may do so instead of requiring its removal and correction, in which case the Contract Sum may be reduced as appropriate and equitable.

5.17 CLEAN UP

Contractor shall at all times keep the Project site, including hauling routes, infrastructures, utilities, and storage areas, free from accumulations of waste materials. Before completing the Work, Contractor shall remove from the premises its rubbish, tools, scaffolding, equipment, and materials. Upon completing the Work, Contractor shall leave the Project site in a clean, neat, and orderly condition satisfactory to Owner. If Contractor fails to clean up as provided herein, and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.

5.18 ACCESS TO WORK

Contractor shall provide Owner and A/E access to the Work in progress wherever located.

5.19 OTHER CONTRACTS

Owner may undertake or award other contracts for additional work at or near the Project site. Contractor shall reasonably cooperate with the other contractors and with Owner's employees and shall carefully adapt scheduling and perform the Work in accordance with these Contract Documents to reasonably accommodate the other work.

5.20 SUBCONTRACTORS AND SUPPLIERS

A. Before submitting the first Application for Payment, Contractor shall furnish in writing to Owner the names, addresses, and telephone numbers of all Subcontractors, as well as suppliers providing materials in excess of $2,500. Contractor shall utilize Subcontractors and suppliers which are experienced and qualified, and meet the requirements of the Contract Documents, if any. Contractor shall not utilize any Subcontractor or supplier to whom the Owner has a reasonable objection, and shall obtain Owner's written consent before making any substitutions or additions.

B. All Subcontracts must be in writing. By appropriate written agreement, Contractor shall require each Subcontractor, so far as applicable to the Work to be performed by the Subcontractor, to be bound to Contractor by terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities which Contractor assumes toward Owner in accordance with the Contract Documents. Each Subcontract shall preserve and protect the rights of Owner in accordance with the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. However, nothing in this paragraph shall be construed to alter the contractual relations between Contractor and its Subcontractors with respect to insurance or bonds.

C. Contractor shall schedule, supervise, and coordinate the operations of all Subcontractors. No Subcontracting of any of the Work shall relieve Contractor from its responsibility for the performance of the Work in accordance with the Contract Documents or any other obligations of the Contract Documents.

D. Each subcontract agreement for a portion of the Work is hereby assigned by Contractor to Owner provided that:

1. The assignment is effective only after termination by Owner for cause pursuant to section 9.01 and only for those Subcontracts which Owner accepts by notifying the Subcontractor in writing; and

2. After the assignment is effective, Owner will assume all future duties and obligations toward the Subcontractor which Contractor assumed in the Subcontract.

3. The assignment is subject to the prior rights of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.

5.21 WARRANTY OF CONSTRUCTION

A. In addition to any special warranties provided elsewhere in the Contract Documents, Contractor warrants that all Work conforms to the requirements of the Contract Documents and is free of any defect in equipment, material, or design furnished, or workmanship performed, by Contractor.

B. With respect to all warranties, express or implied, for Work performed or materials furnished according to the Contract Documents, Contractor shall:

1. Obtain all warranties that would be given in normal commercial practice;

2. Require all warranties to be executed, in writing, for the benefit of Owner;

3. Enforce all warranties for the benefit of Owner, if directed by Owner; and

4. Be responsible to enforce any subcontractor's, manufacturer's, or supplier's warranty should they extend beyond the period specified in the Contract Documents.

C. The obligations under this section shall survive Final Acceptance.

5.22 INDEMNIFICATION

A. Contractor shall defend, indemnify, and hold Owner and A/E harmless from and against all claims, demands, losses, damages, or costs, including but not limited to damages arising out of bodily injury or death to persons and damage to property, caused by or resulting from:

1. The sole negligence of Contractor or any of its Subcontractors;

2. The concurrent negligence of Contractor, or any Subcontractor, but only to the extent of the negligence of Contractor or such Subcontractor; and

3. The use of any design, process, or equipment which constitutes an infringement of any United States patent presently issued, or violates any other proprietary interest, including copyright, trademark, and trade secret.

B. In any action against Owner and any other entity indemnified in accordance with this section, by any employee of Contractor, its Subcontractors, Sub-subcontractors, agents, or anyone directly or indirectly employed by any of them, the indemnification obligation of this section shall not be limited by a limit on the amount or type of damages, compensation, or benefits payable by or for Contractor or any Subcontractor under RCW Title 51, the Industrial Insurance Act, or any other employee benefit acts. In addition, Contractor waives immunity as to Owner and A/E only, in accordance with RCW Title 51.

PART 6 - PAYMENTS AND COMPLETION

6.01 CONTRACT SUM

Owner shall pay Contractor the Contract Sum for performance of the Work, in accordance with the Contract Documents. The Contract Sum shall include all taxes imposed by law and properly chargeable to the Project, including sales tax.

6.02 SCHEDULE OF VALUES

Before submitting its first Application for Payment, Contractor shall submit to Owner for approval a breakdown allocating the total Contract Sum to each principle category of work, in such detail as requested by Owner ("Schedule of Values"). The approved Schedule of Values shall include appropriate amounts for demobilization, record drawings, O&M manuals, and any other requirements for Project closeout, and shall be used by Owner as the basis for progress payments. Payment for Work shall be made only for and in accordance with those items included in the Schedule of Values.

6.03 APPLICATION FOR PAYMENT

A. At monthly intervals, unless determined otherwise by Owner, Contractor shall submit to Owner an itemized Application for Payment for Work completed in accordance with the Contract Documents and the approved Schedule of Values. Each application shall be supported by such substantiating data as Owner may require.

B. By submitting an Application for Payment, Contractor is certifying that all Subcontractors have been paid, less earned retainage in accordance with RCW 60.28.010, as their interests appeared in the last preceding certificate of payment. By submitting an Application for Payment, Contractor is recertifying that the representations set forth in section 1.03 are true and correct, to the best of Contractor's knowledge, as of the date of the Application for Payment.

C. At the time it submits an Application for Payment, Contractor shall analyze and reconcile, to the satisfaction of Owner, the actual progress of the Work with the Progress Schedule.

D. If authorized by Owner, the Application for Payment may include request for payment for material delivered to the Project site and suitably stored, or for completed preparatory work. Payment may similarly be requested for material stored off the Project site, provided Contractor complies with or furnishes satisfactory evidence of the following:

1. The material will be placed in a warehouse that is structurally sound, dry, lighted and suitable for the materials to be stored;

2. The warehouse is located within a 10-mile radius of the Project. Other locations may be utilized, if approved in writing, by Owner;

3. Only materials for the Project are stored within the warehouse (or a secure portion of a warehouse set aside for the Project);

4. Contractor furnishes Owner a certificate of insurance extending Contractor's insurance coverage for damage, fire, and theft to cover the full value of all materials stored, or in transit;

5. The warehouse (or secure portion thereof) is continuously under lock and key, and only Contractor's authorized personnel shall have access;

6. Owner shall at all times have the right of access in company of Contractor;

7. Contractor and its surety assume total responsibility for the stored materials; and

8. Contractor furnishes to Owner certified lists of materials stored, bills of lading, invoices, and other information as may be required, and shall also furnish notice to Owner when materials are moved from storage to the Project site.

6.04 PROGRESS PAYMENTS

A. Owner shall make progress payments, in such amounts as Owner determines are properly due, within 30 days after receipt of a properly executed Application for Payment. Owner shall notify Contractor in accordance with RCW 39.76 if the

Application for Payment does not comply with the requirements of the Contract Documents.

B. Owner shall retain 5% of the amount of each progress payment until 45 days after Final Acceptance and receipt of all documents required by law or the Contract Documents, including, at Owner's request, consent of surety to release of the retainage. In accordance with RCW 60.28, Contractor may request that monies reserved be retained in a fund by Owner, deposited by Owner in a bank or savings and loan, or placed in escrow with a bank or trust company to be converted into bonds and securities to be held in escrow with interest to be paid to Contractor. Owner may permit Contractor to provide an appropriate bond in lieu of the retained funds.

C. Title to all Work and materials covered by a progress payment shall pass to Owner at the time of such payment free and clear of all liens, claims, security interests, and encumbrances. Passage of title shall not, however, relieve Contractor from any of its duties and responsibilities for the Work or materials, or waive any rights of Owner to insist on full compliance by Contractor with the Contract Documents.

D. Payments due and unpaid in accordance with the Contract Documents shall bear interest as specified in RCW 39.76.

6.05 PAYMENTS WITHHELD

A. Owner may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any payment to such extent as may be necessary to protect Owner from loss or damage for reasons including but not limited to:

1. Work not in accordance with the Contract Documents;

2. Reasonable evidence that the Work required by the Contract Documents cannot be completed for the unpaid balance of the Contract Sum;

3. Work by Owner to correct defective Work or complete the Work in accordance with section 5.17;

4. Failure to perform in accordance with the Contract Documents; or

5. Cost or liability that may occur to Owner as the result of Contractor's fault or negligent acts or omissions.

B. In any case where part or all of a payment is going to be withheld for unsatisfactory performance, Owner shall notify Contractor in accordance with RCW 39.76.

6.06 RETAINAGE AND BOND CLAIM RIGHTS

RCW chapters 39.08 and 60.28, concerning the rights and responsibilities of Contractor and Owner with regard to the performance and payment bonds and retainage, are made a part of the Contract Documents by reference as though fully set forth herein.

6.07 SUBSTANTIAL COMPLETION

Substantial Completion is the stage in the progress of the Work (or portion thereof designated and approved by Owner) when the construction is sufficiently complete, in accordance with the Contract Documents, so Owner can fully occupy the Work (or the designated portion thereof) for the use for which it is intended. All Work other than incidental corrective or punch list work shall be completed. Substantial Completion shall not have been achieved if all systems and parts are not functional, if utilities are not connected and operating normally, if all required occupancy permits have not been issued, or if the Work is not accessible by normal vehicular and pedestrian traffic routes. The date Substantial Completion is achieved shall be established in writing by Owner. Contractor may request an early date of Substantial Completion which must be approved by Change Order. Owner's occupancy of the Work or designated portion thereof does not necessarily indicate that Substantial Completion has been achieved.

6.08 PRIOR OCCUPANCY

A. Owner may, upon written notice thereof to Contractor, take possession of or use any completed or partially completed portion of the Work ("Prior Occupancy") at any time prior to Substantial Completion. Unless otherwise agreed in writing, Prior Occupancy shall not: be deemed an acceptance of any portion of the Work; accelerate the time for any payment to Contractor; prejudice any rights of Owner provided by any insurance, bond, guaranty, or the Contract Documents; relieve Contractor of the risk of loss or any of the obligations established by the Contract Documents; establish a date for termination or partial termination of the assessment of liquidated damages; or constitute a waiver of claims.

B. Notwithstanding anything in the preceding paragraph, Owner shall be responsible for loss of or damage to the Work resulting from Prior Occupancy. Contractor's one year duty to repair and any system warranties shall begin on building systems activated and used by Owner as agreed in writing by Owner and Contractor.

6.09 FINAL COMPLETION, ACCEPTANCE, AND PAYMENT

A. Final Completion shall be achieved when the Work is fully and finally complete in accordance with the Contract Documents. The date Final Completion is achieved shall be established by Owner in writing.

B. Final Acceptance is the formal action of Owner acknowledging Final Completion. Prior to Final Acceptance, Contractor shall, in addition to all other requirements in the Contract Documents, submit to Owner a written notice of any outstanding disputes or claims between Contractor and any of its Subcontractors, including the amounts and other details thereof. Neither Final Acceptance, nor final payment, shall release Contractor or its sureties from any obligations of these Contract Documents or the Public Works Bond, or constitute a waiver of any claims by Owner arising from Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Acceptance of final payment by Contractor, or any Subcontractor, shall constitute a waiver and release to Owner of all claims by Contractor, or any such Subcontractor, for an increase in the Contract Sum or the Contract Time, and for

every act or omission of Owner relating to or arising out of the Work, except for those Claims made in accordance with the procedures, including the time limits, set forth in part 8.

PART 7 - CHANGES

7.01 CHANGE IN THE WORK

A. Owner may, at any time and without notice to Contractor's surety, order additions, deletions, revisions, or other changes in the Work. These changes in the Work shall be incorporated into the Contract Documents through the execution of Change Orders. If any change in the Work ordered by Owner causes an increase or decrease in the Contract Sum or the Contract Time, an equitable adjustment shall be made as provided in section 7.02 or 7.03, respectively, and such adjustment(s) shall be incorporated into a Change Order.

B. If Owner desires to order a change in the Work, it may request a written Change Order proposal from Contractor. Contractor shall submit a Change Order proposal within 14 days of the request from Owner, or within such other period as mutually agreed. Contractor's Change Order proposal shall be full compensation for implementing the proposed change in the Work, including any adjustment in the Contract Sum or Contract Time, and including compensation for all delays in connection with such change in the Work and for any expense or inconvenience, disruption of schedule, or loss of efficiency or productivity occasioned by the change in the Work.

C. Upon receipt of the Change Order proposal, or a request for equitable adjustment in the Contract Sum or Contract Time, or both, as provided in sections 7.02 and 7.03, Owner may accept or reject the proposal, request further documentation, or negotiate acceptable terms with Contractor. Pending agreement on the terms of the Change Order, Owner may direct Contractor to proceed immediately with the Change Order Work. Contractor shall not proceed with any change in the Work until it has obtained Owner's approval. All Work done pursuant to any Owner-directed change in the Work shall be executed in accordance with the Contract Documents.

D. If Owner and Contractor reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, such agreement shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of all claims for time and for direct, indirect, and consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity, related to any Work either covered or affected by the Change Order, or related to the events giving rise to the request for equitable adjustment.

E. If Owner and Contractor are unable to reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, Contractor may at any time in writing, request a final offer from Owner. Owner shall provide Contractor with its written response within 30 days of Contractor's request. Owner may also provide Contractor with a final offer at any time. If Contractor rejects Owner's final offer, or the parties are otherwise unable to reach agreement, Contractor's only remedy shall be to file a Claim as provided in part 8.

7.02 CHANGE IN THE CONTRACT SUM

A. General Application

1. The Contract Sum shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Sum in its Change Order proposal.

2. If the cost of Contractor's performance is changed due to the fault or negligence of Owner, or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Sum in accordance with the following procedure. No change in the Contract Sum shall be allowed to the extent: Contractor's changed cost of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible; the change is concurrently caused by Contractor and Owner; or the change is caused by an act of Force Majeure as defined in Section 3.05.

a. A request for an equitable adjustment in the Contract Sum shall be based on written notice delivered to Owner within 7 days of the occurrence of the event giving rise to the request. For purposes of this part, "occurrence" means when Contractor knew, or in its diligent prosecution of the Work should have known, of the event giving rise to the request. If Contractor believes it is entitled to an adjustment in the Contract Sum, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such records and, if requested shall promptly furnish copies of such records to Owner.

b. Contractor shall not be entitled to any adjustment in the Contract Sum for any occurrence of events or costs that occurred more than 7 days before Contractor's written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the Contract Sum; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Sum requested. Failure to properly give such written notice shall, to the extent Owner’s interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

c. Within 30 days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph a. above with additional supporting data. Such additional data shall include, at a minimum: the amount of compensation requested, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the damages claimed, but that the damages claimed were actually a result of the act, event, or condition complained of and that the Contract Documents provide entitlement to an equitable adjustment to Contractor for such act, event, or condition; and documentation sufficiently detailed to permit an informed analysis of the request by Owner. When the request for compensation relates to a delay, or other change in Contract Time, Contractor shall demonstrate the impact on the critical path, in accordance with section 7.03C. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner's interests are-prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

d. Pending final resolution of any request made in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.

e. Any requests by Contractor for an equitable adjustment in the Contract Sum and in the Contract Time that arise out of the same event(s) shall be submitted together.

3. The value of any Work covered by a Change Order, or of any request for an equitable adjustment in the Contract Sum, shall be determined by one of the following methods:

a. On the basis of a fixed price as determined in paragraph 7.02B.

b. By application of unit prices to the quantities of the items involved as determined in paragraph 7.02C.

c. On the basis of time and material as determined in paragraph 7.02D.

4. When Owner has requested Contractor to submit a Change Order proposal, Owner may direct Contractor as to which method in subparagraph 3. above to use when submitting its proposal. Otherwise, Contractor shall determine the value of the Work, or of a request for an equitable adjustment, on the basis of the fixed price method.

B. Change Order Pricing -- Fixed Price

When the fixed price method is used to determine the value of any Work covered by a Change Order, or of a request for an equitable adjustment in the Contract Sum, the following procedures shall apply:

1. Contractor's Change Order proposal, or request for adjustment in the Contract Sum, shall be accompanied by a complete itemization of the costs, including labor, material, subcontractor costs, and overhead and profit. The costs shall be itemized in the manner set forth below, and shall be submitted on breakdown sheets in a form approved by Owner.

2. All costs shall be calculated based upon appropriate industry standard methods of calculating labor, material quantities, and equipment costs.

3. If any of Contractor's pricing assumptions are contingent upon anticipated actions of Owner, Contractor shall clearly state them in the proposal or request for an equitable adjustment.

4. The cost of any additive or deductive changes in the Work shall be calculated as set forth below, except that overhead and profit shall not be included on deductive changes in the Work. Where a change in the Work involves additive and deductive work by the same Contractor or Subcontractor, small tools, overhead, profit, bond and insurance markups will apply to the net difference.

5. If the total cost of the change in the Work or request for equitable adjustment does not exceed $1,000, Contractor shall not be required to submit a breakdown if the description of the change in the Work or request for equitable adjustment is sufficiently definitive for Owner to determine fair value.

6. If the total cost of the change in the Work or request for equitable adjustment is between $1,000 and $2,500, Contractor may submit a breakdown in the following level of detail if the description of the change in the Work or if the request for equitable adjustment is sufficiently definitive to permit the Owner to determine fair value:

   a. lump sum labor;

   b. lump sum material;

   c. lump sum equipment usage;
   d. overhead and profit as set forth below; and

   e. insurance and bond costs as set forth below.

7. Any request for adjustment of Contract Sum based upon the fixed price method shall include only the following items:

   a. Craft labor costs: These are the labor costs determined by multiplying the estimated or actual additional number of craft hours needed to perform the change in the Work by the hourly labor costs. Craft hours should cover direct labor, as well as indirect labor due to trade inefficiencies. The hourly costs shall be based on the following:

      (1) Basic wages and benefits: Hourly rates and benefits as stated on the Department of Labor and Industries approved "statement of intent to pay prevailing wages." Direct supervision shall be a reasonable percentage not to exceed 15% of the cost of direct labor. No supervision markup shall be allowed for a working supervisor's hours.

      (2) Worker's insurance: Direct contributions to the state of Washington for industrial insurance; medical aid; and supplemental pension, by the class and rates established by the Department of Labor and Industries.

      (3) Federal insurance: Direct contributions required by the Federal Insurance Compensation Act; Federal Unemployment Tax Act; and the State Unemployment Compensation Act.

(4) Travel allowance: Travel allowance and/or subsistence, if applicable, not exceeding those allowances established by regional labor union agreements, which are itemized and identified separately.

(5) Safety: Cost incurred due to the Washington Industrial Safety and Health Act, which shall be a reasonable percentage not to exceed 2% of the sum of the amounts calculated in (1), (2), and (3) above.

b. Material costs: This is an itemization of the quantity and cost of materials needed to perform the change in the Work. Material costs shall be developed first from actual known costs, second from supplier quotations or if these are not available, from standard industry pricing guides. Material costs shall consider all available discounts. Freight costs, express charges, or special delivery charges, shall be itemized.

c. Equipment costs: This is an itemization of the type of equipment and the estimated or actual length of time the construction equipment appropriate for the Work is or will be used on the change in the Work. Costs will be allowed for construction equipment only if used solely for the changed Work, or for additional rental costs actually incurred by the Contractor. Equipment charges shall be computed on the basis of actual invoice costs or if owned, from the current edition of one of the following sources:

(1) Associated General Contractors - Washington State Department of Transportation (AGC WSDOT) Equipment Rental Agreement; 1987 edition.

(2) The state of Washington Utilities and Transportation Commission for trucks used on highways.

(3) The National Electrical Contractors Association for equipment used on electrical work.

(4) The Mechanical Contractors Association of America for equipment used on mechanical work.

The Data Quest Rental Rate (Blue Book) shall be used as a basis for establishing rental rates of equipment not listed in the above sources. The maximum rate for standby equipment shall not exceed that shown in the AGC WSDOT Equipment Rental Agreement, 1987 edition.

d. Allowance for small tools, expendables & consumable supplies: Small tools consist of tools which cost $250 or less and are normally furnished by the performing contractor. The maximum rate for small tools shall not exceed the following:

(1) For Contractor, 3% of direct labor costs.

(2) For Subcontractors, 5% of direct labor costs.

Expendables and consumable supplies directly associated with the change in Work must be itemized.

e. Subcontractor costs: This is defined as payments Contractor makes to Subcontractors-for changed Work performed by Subcontractors of any tier. The Subcontractors' cost of Work shall be calculated and itemized in the same manner as prescribed herein for Contractor.

f. Allowance for overhead: This is defined as costs of any kind attributable to direct and indirect delay, acceleration, or impact, added to the total cost to Owner of any change in the Contract Sum but not to the cost of any change in the Contract Time for which contractor has been compensated pursuant to the conditions set forth in Section 7.03. This allowance shall compensate Contractor for all noncraft labor, temporary construction facilities, field engineering, schedule updating, as-built drawings, home office cost, B&O taxes, office engineering, estimating costs, additional overhead because of extended time, and any other cost incidental to the change in the Work. It shall be strictly limited in all cases to a reasonable amount, mutually acceptable, or if none can be agreed upon to an amount not to exceed the rates below:

(1). For projects where the Contract Award Amount is under $3 million, the following shall apply:

(a) For Contractor, for any Work actually performed by Contractor's own forces, 16% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(b) For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 16% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(c) For Contractor, for any work performed by its Subcontractor(s), 6% of the first $50,000 of the amount due each Subcontractor, and 4% of the remaining amount if any.

(d) For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first $50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.

(e) The cost to which overhead is to be applied shall be determined in accordance with subparagraphs a.-e. above.

(2). For projects where the Contract Award Amount is equal to or exceeds $3 million, the following shall apply:

(a) For Contractor, for any Work actually performed by Contractor's own forces,12% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(b) For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 12% of the first $50,000 of the cost, and 4% of the remaining cost, if any.

(c) For Contractor, for any Work performed by its Subcontractor(s), 4% of the first $50,000 of the amount due each Subcontractor, and 2% of the remaining amount if any.

(d) For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first $50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.

(e) The cost to which overhead is to be applied shall be determined in accordance with subparagraphs a.-e. above.

g. Allowance for profit: This is an amount to be added to the cost of any change in contract sum, but not to the cost of change in Contract Time for which contractor has been compensated pursuant to the conditions set forth in section 7.03. It shall be limited to a reasonable amount, mutually acceptable, or if none can be agreed upon, to an amount not to exceed the rates below:

(1) For Contractor or Subcontractor of any tier for work performed by their forces, 6% of the cost developed in accordance with 7.02 b. 7a.- e. above.

(2) For Contractor or Subcontractor of any tier for work performed by a subcontractor of a lower tier, 4% of the Subcontractor cost developed in accordance with 7.02 b. 7a.-h.

h. Cost of change in insurance or bond premium: This is defined as:

(1) Contractor's liability insurance: The cost of any changes in Contractor's liability insurance arising directly from execution of the Change Order; and

(2) Public works bond: The cost of the additional premium for Contractor's bond arising directly from the changed Work.

The costs of any change in insurance or bond premium shall be added after overhead and allowance for profit are calculated in accordance with subparagraph f. and g. above.

C. Change Order Pricing -- Unit Prices

1. Whenever Owner authorizes Contractor to perform Work on a unit-price basis, Owner's authorization shall clearly state:

   a. Scope of work to be performed;

   b. Type of reimbursement including pre-agreed rates for material quantities; and

   c. Cost limit of reimbursement.

2. Contractor shall:

   a. Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, Contractor shall identify workers assigned to the Change Order Work and areas in which they are working;

   b. Leave access as appropriate for quantity measurement; and

   c. Not exceed any cost limit(s) without Owner's prior written approval.

3. Contractor shall submit costs in accordance with paragraph 7.02B. and satisfy the following requirements:

   a. Unit prices shall include reimbursement for all direct and indirect costs of the Work, including overhead and profit, and bond and insurance costs; and

   b. Quantities must be supported by field measurement statements signed by Owner.

D. Change Order Pricing -- Time-and-Material Prices

1. Whenever Owner authorizes Contractor to perform Work on a time-and-material basis, Owner's authorization shall clearly state:

   a. Scope of Work to be performed;

   b. Type of reimbursement including pre-agreed rates, if any, for material quantities or labor; and

   c. Cost limit of reimbursement.

2. Contractor shall:

   a. Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, identify workers assigned to the Change Order Work and areas in which they are working;

   b. Identify on daily time sheets all labor performed in accordance with this authorization. Submit copies of daily time sheets within 2 working days for Owner's review;

   c. Leave access as appropriate for quantity measurement;

   d. Perform all Work in accordance with this section as efficiently as possible; and

   e. Not exceed any cost limit(s) without Owner's prior written approval.

3. Contractor shall submit costs in accordance with paragraph 7.02B and additional verification supported by:

   a. Labor detailed on daily time sheets; and

   b. Invoices for material.

7.03 CHANGE IN THE CONTRACT TIME

A. The Contract Time shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Time in its Change Order proposal.

B. If the time of Contractor's performance is changed due to an act of Force Majeure, or due to the fault or negligence of Owner or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Time in accordance with the following procedure. No adjustment in the Contract Time shall be allowed to the extent Contractor's changed time of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible.

1. A request for an equitable adjustment in the Contract Time shall be based on written notice delivered within 7 days of the occurrence of the event giving rise to the request. If Contractor believes it is entitled to adjustment of Contract Time, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such record and if requested, shall promptly furnish copies of such record to Owner.

2. Contractor shall not be entitled to an adjustment in the Contract Time for any events that occurred more than 7 days before Contractor's written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the Contract Time; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Time requested.
   Failure to properly give such written notice shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

3. Within 30 days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph 7.03B.2 with additional supporting data. Such additional data shall include, at a minimum: the amount of delay claimed, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the delay claimed, but that the delay claimed was actually a result of the act, event, or condition complained of, and that the Contract Documents provide entitlement to an equitable adjustment in Contract Time for such act, event, or condition; and supporting documentation sufficiently detailed to permit an informed analysis of the request by Owner. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

4. Pending final resolution of any request in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.

C. Any change in the Contract Time covered by a Change Order, or based on a request for an equitable adjustment in the Contract Time, shall be limited to the change in the critical path of Contractor's schedule attributable to the change of Work or event(s) giving rise to the request for equitable adjustment. Any Change Order proposal or request for an adjustment in the Contract Time shall demonstrate the impact on the critical path of the schedule. Contractor shall be responsible for showing clearly on the Progress Schedule that the change or event: had a specific impact on the critical path, and except in case of concurrent delay, was the sole cause of such impact; and could not have been avoided by resequencing of the Work or other reasonable alternatives.

D. Contractor may request compensation for the cost of a change in Contract Time in accordance with this paragraph, 7.03D, subject to the following conditions:

1. The change in Contract Time shall solely be caused by the fault or negligence of Owner or A/E;

2. Compensation under this paragraph is limited to changes in Contract Time for which Contractor is not entitled to be compensated under section 7.02;

3. Contractor shall follow the procedure set forth in paragraph 7.03B;

4. Contractor shall establish the extent of the change in Contract Time in accordance with paragraph 7.03C; and

5. The daily cost of any change in Contract Time shall be limited to the items below, less funds that may have been paid pursuant to a change in the Contract Sum that contributed to this change in Contract Time:

   a. cost of nonproductive field supervision or labor extended because of the delay;

   b. cost of weekly meetings or similar indirect activities extended because of the delay;

   c. cost of temporary facilities or equipment rental extended because of the delay;

   d. cost of insurance extended because of the delay;

   e. general and administrative overhead in an amount to be agreed upon, but not to exceed 3% of Contract Sum divided by the Contract Time for each day of the delay.

PART 8 - CLAIMS AND DISPUTE RESOLUTION

8.01 CLAIMS PROCEDURE

A. If the parties fail to reach agreement on the terms of any Change Order for Owner-directed Work as provided in section 7.01, or on the resolution of any request for an equitable adjustment in the Contract Sum as provided in section 7.02 or the Contract Time as provided in section 7.03, Contractor's only remedy shall be to file a Claim with Owner as provided in this section.

B. Contractor shall file its Claim within the earlier of: 120 days from Owner's final offer in accordance with either paragraph 7.01E or the date of Final Acceptance.

C. The Claim shall be deemed to cover all changes in cost and time (including direct, indirect, impact, and consequential) to which Contractor may be entitled. It shall be fully substantiated and documented. At a minimum, the Claim shall contain the following information:

1. A detailed factual statement of the Claim for additional compensation and time, if any, providing all necessary dates, locations, and items of Work affected by the Claim;

2. The date on which facts arose which gave rise to the Claim

3. The name of each employee of Owner or A/E knowledgeable about the Claim;

4. The specific provisions of the Contract Documents which support the Claim;

5. The identification of any documents and the substance of any oral communications that support the Claim;

6. Copies of any identified documents, other than the Contract Documents, that support the Claim;

7. If an adjustment in the Contract Time is sought: the specific days and dates for which it is sought; the specific reasons Contractor believes an extension in the Contract Time should be granted; and Contractor's analysis of its Progress Schedule to demonstrate the reason for the extension in Contract Time;

8. If an adjustment in the Contract Sum is sought, the exact amount sought and a breakdown of that amount into the categories set forth in, and in the detail required by, section 7.02; and

9. A statement certifying, under penalty of perjury, that the Claim is made in good faith, that the supporting cost and pricing data are true and accurate to the best of Contractor's knowledge and belief, that the Claim is fully supported by the accompanying data, and that the amount requested accurately reflects the adjustment in the Contract Sum or Contract Time for which Contractor believes Owner is liable.

D. After Contractor has submitted a fully documented Claim that complies with all applicable provisions of parts 7 and 8, Owner shall respond, in writing, to Contractor as follows:

1. If the Claim amount is less than $50,000, with a decision within 60 days from the date the Claim is received; or

2. If the Claim amount is $50,000 or more, with a decision within 60 days from the date the Claim is received, or with notice to Contractor of the date by which it will render its decision. Owner will then respond with a written decision in such additional time.

E. To assist in the review of Contractor's Claim, Owner may visit the Project site, or request additional information, in order to fully evaluate the issues raised by the Claim. Contractor shall proceed with performance of the Work pending final resolution of any Claim. Owner's written decision as set forth above shall be final and conclusive as to all matters set forth in the Claim, unless Contractor follows the procedure set forth in section 8.02.

F. Any Claim of the Contractor against the Owner for damages, additional compensation, or additional time, shall be conclusively deemed to have been waived by the Contractor unless timely made in accordance with the requirements of this section.

8.02 ARBITRATION

A. If Contractor disagrees with Owner's decision rendered in accordance with paragraph 8.01D, Contractor shall provide Owner with a written demand for arbitration. No demand for arbitration of any such Claim shall be made later than 30 days after the date of Owner's decision on such Claim; failure to demand arbitration within said 30 day period shall result in Owner's decision being final and binding upon Contractor and its Subcontractors.

B. Notice of the demand for arbitration shall be filed with the American Arbitration Association (AAA), with a copy provided to Owner. The parties shall negotiate or mediate under the Voluntary Construction Mediation Rules of the AAA, or mutually acceptable service, before seeking arbitration in accordance with the Construction Industry Arbitration Rules of AAA as follows:

1. Disputes involving $30,000 or less shall be conducted in accordance with the Northwest Region Expedited Commercial Arbitration Rules; or

2. Disputes over $30,000 shall be conducted in accordance with the Construction Industry Arbitration Rules of the AAA, unless the parties agree to use the expedited rules.

C. All Claims arising out of the Work shall be resolved by arbitration. The judgment upon the arbitration award may be entered, or review of the award may occur, in the superior court having jurisdiction thereof. No independent legal action relating to or arising from the Work shall be maintained.

D. Claims between Owner and Contractor, Contractor and its Subcontractors, Contractor and A/E, and Owner and A/E shall, upon demand by Owner, be submitted in the same arbitration or mediation.

E. If the parties resolve the Claim prior to arbitration judgment, the terms of the resolution shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of the Claim, including all claims for time and for direct, indirect, or consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity.

8.03 CLAIMS AUDITS

A. All Claims filed against Owner shall be subject to audit at any time following the filing of the Claim. Failure of Contractor, or Subcontractors of any tier, to maintain and retain sufficient records to allow Owner to verify all or a portion of the Claim or to permit Owner access to the books and records of Contractor, or Subcontractors of any tier, shall constitute a waiver of the Claim and shall bar any recovery.

B. In support of Owner audit of any Claim, Contractor shall, upon request, promptly make available to Owner the following documents:

1. Daily time sheets and supervisor's daily reports;
2. Collective bargaining agreements;
3. Insurance, welfare, and benefits records;
4. Payroll registers;
5. Earnings records;
6. Payroll tax forms;
7. Material invoices, requisitions, and delivery confirmations;
8. Material cost distribution worksheet;
9. Equipment records (list of company equipment, rates, etc.);
10. Vendors', rental agencies', Subcontractors', and agents' invoices;
11. Contracts between Contractor and each of its Subcontractors, and all lower-tier Subcontractor contracts and supplier contracts;
12. Subcontractors' and agents' payment certificates;
13. Cancelled checks (payroll and vendors);
14. Job cost report, including monthly totals;
15. Job payroll ledger;
16. Planned resource loading schedules and summaries;
17. General ledger;
18. Cash disbursements journal;
19. Financial statements for all years reflecting the operations on the Work. In addition, the Owner may require, if it deems it appropriate, additional financial statements for 3 years preceding execution of the Work;

20. Depreciation records on all company equipment whether these records are maintained by the company involved, its accountant, or others;

21. If a source other than depreciation records is used to develop costs for Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents;

22. All nonprivileged documents which relate to each and every Claim together with all documents which support the amount of any adjustment in Contract Sum or Contract Time sought by each Claim;

23. Work sheets or software used to prepare the Claim establishing the cost components for items of the Claim including but not limited to labor, benefits and insurance, materials, equipment, Subcontractors, all documents which establish the time periods, individuals involved, the hours for the individuals, and the rates for the individuals; and

24. Work sheets, software, and all other documents used by Contractor to prepare its bid.

C. The audit may be performed by employees of Owner or a representative of Owner. Contractor, and its Subcontractors, shall provide adequate facilities acceptable to Owner, for the audit during normal business hours. Contractor, and all Subcontractors, shall make a good faith effort to cooperate with Owner's auditors.

PART 9 - TERMINATION OF THE WORK

9.01 TERMINATION BY OWNER FOR CAUSE

A. Owner may, upon 7 days written notice to Contractor and to its surety, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for cause upon the occurrence of any one or more of the following events:

1. Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Substantial Completion of the Work within the Contract Time;

2. Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency;

3. Contractor fails in a material way to replace or correct Work not in conformance with the Contract Documents;

4. Contractor repeatedly fails to supply skilled workers or proper materials or equipment;

5. Contractor repeatedly fails to make prompt payment due to Subcontractors or for labor;

6. Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction; or

7. Contractor is otherwise in material breach of any provision of the Contract Documents.

B. Upon termination, Owner may at its option:

1. Take possession of the Project site and take possession of or use all materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor to maintain the orderly progress of, and to finish, the Work;

2. Accept assignment of subcontracts pursuant to section 5.21; and

3. Finish the Work by whatever other reasonable method it deems expedient.

C. Owner's rights and duties upon termination are subject to the prior rights and duties of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.

D. When Owner terminates the Work in accordance with this section, Contractor shall take the actions set forth in paragraph 9.02B, and shall not be entitled to receive further payment until the Work is accepted.

E. If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including compensation for A/E's services and expenses made necessary thereby and any other extra costs or damages incurred by Owner in completing the Work, or as a result of Contractor's actions, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner. These obligations for payment shall survive termination.

F. Termination of the Work in accordance with this section shall not relieve Contractor or its surety of any responsibilities for Work performed.

G. If Owner terminates Contractor for cause, and it is later determined that none of the circumstances set forth in paragraph 9.01A exist, then such termination shall be deemed a termination for convenience pursuant to section 9.02.

9.02 TERMINATION BY OWNER FOR CONVENIENCE

A. Owner may, upon written notice, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for the convenience of Owner.

B. Unless Owner directs otherwise, after receipt of a written notice of termination for either cause or convenience, Contractor shall promptly:

1. Stop performing Work on the date and as specified in the notice of termination;

2. Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of such portion of the Work as is not terminated;

3. Cancel all orders and subcontracts, upon terms acceptable to Owner, to the extent that they relate to the performance of Work terminated;

4. Assign to Owner all of the right, title, and interest of Contractor in all orders and subcontracts;

5. Take such action as may be necessary or as directed by Owner to preserve and protect the Work, Project site, and any other property related to this Project in the possession of Contractor in which Owner has an interest; and

6. Continue performance only to the extent not terminated.

C. If Owner terminates the Work or any portion thereof for convenience, Contractor shall be entitled to make a request for an equitable adjustment for its reasonable direct costs incurred prior to the effective date of the termination, plus a reasonable allowance for overhead and profit on Work performed prior to termination, plus the reasonable administrative costs of the termination, but shall not be entitled to any other costs or damages, whatsoever, provided however, the total sum payable upon termination shall not exceed the Contract Sum reduced by prior payments. Contractor shall be required to make its request in accordance with the provisions of part 7.

D. If Owner terminates the Work or any portion thereof for convenience, the Contract Time shall be adjusted as determined by Owner.

PART 10 - MISCELLANEOUS PROVISIONS

10.01 GOVERNING LAW

The Contract Documents and the rights of the parties herein shall be governed by the laws of the state of Washington. Venue shall be in the county in which Owner's principal place of business is located, unless otherwise specified.

10.02 SUCCESSORS AND ASSIGNS

Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to the other party hereto and to partners, successors, assigns, and legal representatives of such other party in respect to covenants, agreements, and obligations contained in the Contract Documents. Neither party shall assign the Work without written consent of the other, except that Contractor may assign the Work for security purposes, to a bank or lending institution authorized to do business in the state of Washington. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations set forth in the Contract Documents.

10.03 MEANING OF WORDS

Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Reference to standard specifications, manuals, or codes of any technical society, organization, or association, or to the code of any governmental authority, whether such reference be specific or by implication, shall be to the latest standard specification, manual, or code in effect on the date for submission of bids, except as may be otherwise specifically stated. Wherever in these Drawings and Specifications an article, device, or piece of equipment is referred to in the singular manner, such reference shall apply to as many such articles as are shown on the drawings, or required to complete the installation.

10.04 RIGHTS AND REMEDIES

No action or failure to act by Owner or A/E shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall such action or failure to act constitute approval of an acquiescence in a breach therein, except as may be specifically agreed in writing.

10.05 CONTRACTOR REGISTRATION

Pursuant to RCW 39.06, Contractor shall be registered or licensed as required by the laws of the State of Washington, including but not limited to RCW 18.27.

10.06 TIME COMPUTATIONS

When computing any period of time, the day of the event from which the period of time begins shall not be counted. The last day is counted unless it falls on a weekend or legal holiday, in which event the period runs until the end of the next day that is not a weekend or holiday. When the period of time allowed is less than 7 days, intermediate Saturdays, Sundays, and legal holidays are excluded from the computation.

10.07 RECORDS RETENTION

The wage, payroll, and cost records of Contractor, and its Subcontractors, and all records subject to audit in accordance with section 8.03, shall be retained for a period of not less than 6 years after the date of Final Acceptance.

10.08 THIRD-PARTY AGREEMENTS

The Contract Documents shall not be construed to create a contractual relationship of any kind between: A/E and Contractor; Owner and any Subcontractor; or any persons other than Owner and Contractor.

10.09 ANTITRUST ASSIGNMENT

Owner and Contractor recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the purchaser. Therefore, Contractor hereby assigns to Owner any and all claims for such overcharges as to goods, materials, and equipment purchased in connection with the Work performed in accordance with the Contract

Documents, except as to overcharges which result from antitrust violations commencing after the Contract Sum is established and which are not passed on to Owner under a Change Order. Contractor shall put a similar clause in its Subcontracts, and require a similar clause in its sub-Subcontracts, such that all claims for such overcharges on the Work are passed to Owner by Contractor.

END OF SECTION 00700

SUPPLEMENTAL CONDITIONS
(Paragraphs keyed to State's General Conditions)

2.04 Builder's Risk – Add the following at the end of paragraph 2.06 A: "For projects not involving New Building Construction, 'Installation Floater' is an acceptable substitute for the Builder's Risk Insurance."

3.02 Replaces Section 3.02 B – CONSTRUCTION SCHEDULE

B. The Progress Schedule shall be in the form of a Critical Path Method (CPM) logic network or, with the approval of the Owner, a bar chart schedule may be submitted. The scheduling of construction is the responsibility of the Contractor and is included in the contract to assure adequate planning and execution of the work. The schedule will be used to evaluate progress of the work for payment based on the Schedule of Values. The schedule shall show the Contractor's planned order and interdependence of activities, and sequence of work. As a minimum the schedule shall include:

- Date of Notice to Proceed;
- Activities (resources, durations, individual responsible for activity, early starts, late starts, early finishes, late finishes, etc.);
- Utility Shutdowns;
- Interrelationships and dependence of activities;
- Planned vs. actual status for each activity;
- Substantial completion;
- Punch list;
- Final inspection;
- Final completion, and
- Float time

The Schedule Duration shall be based on the Contract Time of Completion listed on the Bid Proposal form. The Owner shall not be obligated to accept any Early Completion Schedule suggested by the Contractor. The Contract Time for Completion shall establish the Schedule Completion Date.

If the Contractor feels that the work can be completed in less than the Specified Contract Time, then the Surplus Time shall be considered Project Float. This Float time shall be shown on the Project Schedule. It shall be available to accommodate changes in the work and unforeseen conditions.

Neither the Contractor nor the Owner have exclusive right to this Float Time. It belongs to the project.

3.06 Replaces Section 3.05 A.6 – DELAY

Unusually severe weather, in excess of weather conditions experienced within the area any time in the preceding ten years:

A. Monthly rainfall in excess of the highest monthly rainfall experienced for the same month.
B. Annual rainfall in excess of the highest annual rainfall experienced.
C. Monthly snowfall in excess of the highest monthly snowfall experienced for the same month.
D. Annual snowfall in excess of the highest annual snowfall experienced.
E. Average high temperatures, for the summer months, in excess of the highest temperatures experienced.
F. Average low temperatures for the winter months, lower than the lowest average temperatures experienced.

5.02 Replaces Section 5.02 B – PERMITS, FEES AND NOTICES

B. The actual cost of the general building permit (only) and the public utility hook-up fees will be a direct reimbursement to the Contractor or paid ***directly to the permitting agency*** *by the Owner.* ***Fees for these permits should not be included by the Contractor in his bid amount.***

5.04 Add New Paragraph F – PREVAILING WAGES

Copies of approved Intents to Pay Prevailing Wages for the Contractor and all subcontractors shall be submitted with the Contractor's first application for payment. As additional subcontractors perform work on the project, their approved Intent forms shall be submitted with the Contractor's next application for payment.

The Contractor and all subcontractors shall promptly submit to the Owner certified payroll copies if requested.

5.20 Replace Paragraph A – SUBCONTRACTORS AND SUPPLIERS

A. Before submitting the first Application for Payment, Contractor shall furnish in writing to Owner on Owner provided form(s) the names, addresses, telephone numbers, and Tax Identification Numbers (TIN) of all subcontractors, as well as suppliers providing materials in excess of $2,500.00. The Contractor shall designate whether any of the subcontractors/suppliers are MWBE firms, and indicate the anticipated dollar value of each MWBE subcontract. Contractor shall utilize subcontractors and suppliers, which are experienced and qualified, and meet the requirements of the Contract Documents, if any. Contractor shall not utilize any subcontractor or supplier to whom the Owner has a reasonable objection, and shall obtain Owner's written consent before making any substitutions or additions.

7.01 Add Paragraph F – CHANGE IN THE WORK

F. 1. The Field Authorization (FA) is executed as a directive to proceed with work when the processing time for an approved change order would impact the project.

2. A scope of work must be defined, a maximum not to exceed cost agreed upon, and any estimated modification to the contract completion time determined. The method of final cost verification must be noted and supporting cost data must be submitted in accordance with the requirements of Part 7 of the General Conditions. Upon satisfactory submittal and approval of supporting cost data, the completed FA will be processed into a change order. No payment will be made to the Contractor for FA work until that FA is converted to a Change Order.

10.10 Add Part 10.10 – MINORITY AND WOMEN'S BUSINESS ENTERPRISES (MWBE) PARTICIPATION

In Accordance with the legislative findings and policies set forth in Chapter 39.19 RCW the State of Washington encourages participation in all of its contracts by MWBE firms certified by the Office of Minority and Women's Business Enterprises (OMWBE). Participation may be either on a direct basis in response to this solicitation or as a subcontractor to a Bidder. However, unless required by federal statutes, regulations, grants, or contract terms referenced in the contract documents, no preference will be included in the evaluation of bids, no minimum level of MWBE participation shall be required as a condition for receiving an award, and bids will not be rejected or considered non-responsive on that basis. Any affirmative action requirements set forth in federal regulations or statutes included or referenced in the contract documents will apply. Bidders may contact OMWBE to obtain information on certified firms for potential subcontractors/suppliers.

A. When referred to in this Contract, the terms Minority Business Enterprise (MBE) and Women's Business Enterprise (WBE) will be as defined by OMWBE, WAC 326-02-030.

B. The OMWBE has compiled a directory of certified firms. Copies of this directory may be obtained through the OMWBE. For information regarding the certification process or the certification status of a particular firm, contact:

The OMWBE, 406 South Water, PO Box 41160, Olympia, Washington 98504-1160, telephone (360) 753-9693.

C. Eligible MWBEs

All MWBE firms utilized for this project for voluntary MWBE goals must be certified by Washington State OMWBE.

D. MWBE Voluntary Goals

The Owner has established voluntary goals for MWBE participation for this project. The voluntary goals are set forth in the Advertisement for Bids.

E. If any part of the contract, including the supply of materials and equipment, is anticipated to be subcontracted, then prior to receipt of the first payment, Contractor shall submit, pursuant to Section 5.20 A, a list of all subcontractors/suppliers it intends to use, designate whether

any of the subcontractors/suppliers are MWBE firms, indicate the anticipated dollar value of each MWBE subcontract, and provide Tax Identification Number (TIN).

F. If any part of the contract, including the supply of materials and equipment is actually subcontracted during completion of the work, then prior to final acceptance or completion of the contract or as otherwise indicated in the contract documents, the Contractor shall submit a statement of participation indicating what MWBEs were used and the dollar value of their subcontracts.

G. The provisions of this section are not intended to replace or otherwise change the requirements of RCW 39.30.060. If said statute is applicable to this contract then the failure to comply with RCW 39.30.060 will still render a bid non-responsive.

H. The Contractor shall maintain, for at least three years after completion of this contract, relevant records and information necessary to document the level of utilization of MWBEs and other businesses as subcontractors and suppliers in this contract, as well as any efforts the Contractor makes to increase the participation of MWBEs as listed in section I below. The Contractor shall also maintain, for at least three years after completion of this contract, a record of all quotes, bids, estimates, or proposals submitted to the Contractor by all businesses seeking to participate as subcontractors or suppliers in this contract. The state shall have the right to inspect and copy such records. If this contract involves federal funds, Contractor shall comply with all record keeping requirements set forth in any federal rules, regulations or statutes included or referenced in the contract documents.

I. Bidders shall advertise opportunities for subcontractors or suppliers in a manner reasonably designed to provide MWBEs capable of performing the work with timely notice of such opportunities, and all advertisements shall include a provision encouraging participation by MWBE firms. Advertising may be done through general advertisements (e.g. newspapers, journals, etc.) or by soliciting bids directly from MWBEs. Bidders shall provide MWBEs that express interest with adequate and timely information about plans, specifications, and requirements of the contract.

J. Contractors shall not create barriers to open and fair opportunities for all businesses including MWBEs to participate in all State contracts and to obtain or compete for contracts and subcontracts as sources of supplies, equipment, construction and services. In considering offers from and doing business with subcontractors and suppliers, the Contractor shall not discriminate on the basis of race, color, creed, religion, sex, age, nationality, marital status, or the presence of any mental or physical disability in an otherwise qualified disabled person.

K. Any violation of the mandatory requirements of this part of the contract shall be a material breach of contract for which the Contractor may be subject to a requirement of specific performance, or damages and sanctions provided by contract, by RCW 39.19.090, or by other applicable laws.

END OF SECTION 00800

SECTION 01100

SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Use of premises.
4. Work restrictions.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification:

1. Intersection of Curtis Drive and Sunset Drive, Longview, Washington

B. Owner: Dell Hillger – General Manager, Beacon Hill Water and Sewer District

1. Owner's Representative: Richmond Engineering, 8365 Hogum Bay LN NE, Olympia, WA 98516**.**

C. Construction Manager: Richmond Engineering, 8365 Hogum Bay LN NE, Olympia, WA 98516**.**

1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for Construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

D. Scope of Work: Project consists of constructing, piping, vaults, valves, meters, etc., as shown on plans and specifications to interconnect Beacon Hill Water and Sewer District and City of Longview water systems. Project location is near the intersection of Curtis Drive and Sunset Drive, Longview, Washington.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

C. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.6 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, except otherwise indicated.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Construction Manager's written permission.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

SECTION 01230

ALTERNATES

PART 1 - GENERAL

1.1 DESCRIPTION

A. GENERAL

1. Each bidder shall state in his bid, in the spaces provided therefore in the Bid Form:

   a. His proposal for performing the work of the various Base Bids, as defined in Paragraph 1.2 below;
   b. Additive Alternate proposals, stating the sums to be added to the respective Base Bids for adding items of work listed in Paragraph 1.3 below.

2. All bid prices shall include adjustments in the work of all trades as may be necessary.

3. Materials and specification section numbers listed in Alternate Bid descriptions below are general in nature and list only those materials and associated section numbers which are primary to each respective alternate bid, but are not intended to be all inclusive; Contractor shall provide all other materials and associated work necessary to complete the work of each respective alternate bid which is not otherwise specifically listed.

1.2 BASE BIDS

A. Scope of Work: Project consists of constructing, piping, vaults, valves, meters, etc., as shown on plans and specifications to interconnect Beacon Hill Water and Sewer District and City of Longview water systems. Project location is near the intersection of Curtis Drive and Sunset Drive, Longview, Washington

END OF SECTION 01230

SECTION 01310

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Administrative and supervisory personnel.
3. Project meetings.
4. Requests for Interpretation (RFIs).

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections include the following:

1. Specification 01320 "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
2. Specification 01700 "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Specification 01770 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

3. Number of Copies: Submit one opaque copies of each submittal. Submit PDF copy of transmittal and submittal to Construction Manager.
4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 5 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Construction Manager of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within two days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Construction Manager, but no later than 5 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Construction Manager and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.

b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Preparation of Record Documents.
l. Use of the premises.
m. Work restrictions.
n. Owner's occupancy requirements.
o. Responsibility for temporary facilities and controls.
p. Construction waste management and recycling.
q. Parking availability.
r. Office, work, and storage areas.
s. Equipment deliveries and priorities.
t. First aid.
u. Security.
v. Progress cleaning.
w. Working hours.

3. Minutes: Record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Construction Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. The Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Possible conflicts.
i. Compatibility problems.
j. Time schedules.
k. Weather limitations.
l. Manufacturer's written recommendations.
m. Warranty requirements.
n. Compatibility of materials.
o. Acceptability of substrates.
p. Temporary facilities and controls.

q. Space and access limitations.
r. Regulations of authorities having jurisdiction.
s. Testing and inspecting requirements.
t. Installation procedures.
u. Coordination with other work.
v. Required performance results.
w. Protection of adjacent work.
x. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner, Construction Manager, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.

12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) RFIs.
16) Status of proposal requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at weekly intervals and in conjunction with Progress Meeting. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Construction Manager, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.

8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Construction Manager
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: CSI Form 13.2A. Construction Manager may approve contractor form, submit for approval.

1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Construction Manager's Action: Construction Manager will review each RFI, determine action required, and return it. Allow **seven** working days for Construction Manager's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Incomplete RFIs or RFIs with numerous errors.

2. Construction Manager's action may include a request for additional information, in which case Construction Manager's time for response will start again.
3. Construction Manager's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "General Conditions" Part 7 "Changes."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Construction Manager in writing within five days of receipt of the RFI response.

F. On receipt of Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Construction Manager within five days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use CSI Log Form 13.2B or Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Construction Manager.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Construction Manager's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01320

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.

B. Related Sections include the following:

1. General Conditions 1 Part 6 "Payments and Completion" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit one hard copy and one PDF copy of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Construction Manager's final release or approval.

C. Preliminary Construction Schedule: Submit one hard copy and one PDF copy.

1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities.

D. Contractor's Construction Schedule: Submit one hard copy and one PDF copy of initial schedule, large enough to show entire schedule for entire construction period.

1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

E. Daily Construction Reports: Submit one hard copy and one PDF copy at weekly intervals.

F. Material Location Reports: Submit one hard copy and one PDF copy at weekly intervals.

G. Field Condition Reports: Submit one hard copy and one PDF copy at time of discovery of differing conditions.

H. Special Reports: Submit one hard copy and one PDF copy at time of unusual event.

1.5 QUALITY ASSURANCE

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule or network diagram. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

    a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 15 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than two days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Construction Manager's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

5. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Use of premises restrictions.
    e. Provisions for future construction.
    f. Seasonal variations.
    g. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Startup and placement into final use and operation.

7. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of electrical installation.
    e. Substantial Completion.

2.3 CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within five days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 30 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01320

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Division 1 Section "General Conditions" Part 6 “Payments and Completion” for submitting Applications for Payment and the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 1 Section "Quality Requirements" for submitting test and inspection reports.
5. Division 1 Section "Closeout Procedures" for submitting warranties.
6. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
7. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Division 1 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.
9. Divisions 2 through 16 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Construction Manager's responsive action.

B. Informational Submittals: Written information that does not require Construction Manager's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Construction Manager reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow five days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Owner, or other parties is indicated, allow 10 days for initial review of each submittal.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Construction Manager.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name and address of Construction Manager
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Construction Manager

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Construction Manager will discard submittals received from sources other than Contractor.

1. Transmittal Form: Use AIA Document G810 or CSI Form 12.1A.
2. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Drawing number and detail references, as appropriate.
j. Transmittal number, numbered consecutively.
k. Submittal and transmittal distribution record.
l. Remarks.
m. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are approved.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers,

fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Engineer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Information contained in CAD files may only be used for this project and only by contractor without further approval by Engineer.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic submittals directly to extranet specifically established for Project.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's written recommendations.
    b. Manufacturer's product specifications.
    c. Manufacturer's installation instructions.
    d. Standard color charts.
    e. Manufacturer's catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Mill reports.
    j. Standard product operation and maintenance manuals.
    k. Compliance with specified referenced standards.
    l. Testing by recognized testing agency.
    m. Application of testing agency labels and seals.
    n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit one hard copy and one PDF copy of Product Data, unless otherwise indicated. Construction Manager, will return one PDF copy. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shopwork manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Design calculations.
    j. Compliance with specified standards.
    k. Notation of coordination requirements.
    l. Notation of dimensions established by field measurement.
    m. Relationship to adjoining construction clearly indicated.
    n. Seal and signature of professional engineer if specified.
    o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Number of Copies: Submit two opaque (bond) copies, and one PDF of each submittal. Construction Manager will return one copy.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Construction Manager will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit one set of Samples. Construction Manager will retain.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Number of Copies: Submit one hard copy and one PDF copy of product schedule or list, unless otherwise indicated. Construction Manager will return one copy.

    a. Mark up and retain one returned copy as a Project Record Document.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation" for Construction Manager's action.

G. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 1 Section “General Conditions” Part 6 “Payments and Completion.”

I. Schedule of Values: Comply with requirements specified in Division 1 Section "General Conditions" Part 6 “Payments and Completion.”

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit one hard copy and one PDF copy of subcontractor list, unless otherwise indicated.

    a. Mark up and retain one returned copy as a Project Record Document.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Construction Manager.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 CONSTRUCTION MANAGER'S ACTION

A. General: Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

C. Informational Submittals: Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Construction Manager will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01330

SECTION 01400

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
3. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Construction Manager.

C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer**,** Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Construction Manager**,** testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

A. Experienced in their field.

3.2 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Construction Manager's reference during normal working hours.

3.3 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01400

SECTION 01420

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	ACI International (American Concrete Institute) www.aci-int.org	(248) 848-3700

ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040

ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI www.bicsi.org	(800) 242-7405 (813) 979-1991
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
FM Approvals	FM Approvals www.fmglobal.com	(781) 762-4300
FMRC	Factory Mutual Research (Now FM Global)	
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900

IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (303) 697-8441
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720

PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICBO	International Conference of Building Officials (See ICC)	
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
ICC-ES	ICC Evaluation Service, Inc. www.icc-es.org	(800) 423-6587 (562) 699-0543

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil Available from Defense Standardization Program www.dps.dla.mil	(215) 697-2664

	Available from General Services Administration www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences www.wbdg.org/ccb	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.

1.3 DEFINITIONS

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide bases for supporting posts.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 1 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Water is not available a site. Coordinate for use of water from nearest hydrant.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Connect temporary service to Owner's existing power source, as directed by Owner.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area. Comply with NFPA 241.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads as indicated on Drawings.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 1 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Division 2 Section 02230 "Site Clearing" and 02270 "TESC Planning and Execution."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Storm water Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.

E. Site Enclosure Fence: Before construction operations begin furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner, and Construction Manager with one set of keys.

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

END OF SECTION 01500

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 1 Section "References" for applicable industry standards for products specified.
2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other

designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

    a. Specification Section number and title.
    b. Generic name used in the Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.
    h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within five days after notice to proceed for the Work, submit one hard copy and one PDF copy of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

    a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 15 days after date of commencement of the Work, submit completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Engineer’s Action: Engineer will respond in writing to Contractor within 10 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A form provided by Owner.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified material or product cannot be provided.

b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor **through Construction Manager** of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."

b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Engineer will consider requests for substitution if received within 10 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

SECTION 01650

FACILITY STARTUP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 FACILITY STARTUP

A. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with these general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified.

1. To ensure that the work is ready for full-time operation the procedures include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers and operator training where specified.

B. Notification: Notify the Owner five days prior to starting each system or piece of equipment.

C. Coordination: During the startup period, coordinate the operation of the facility with Owner, subcontractors, Owner’s operators, and manufacturer’s representatives.

D. Furnish test equipment, measuring devices, and supplies required to conduct tests.

E. Maintain the equipment until acceptance. Provide all lubricants, chemicals, and electricity necessary until acceptance.

F. Furnish all expendable supplies, gas, water, etc., required for startup, demonstration and testing and dispose of all waste or used supplies, water, etc.

1.3 SUBMITTALS

A. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording test data.

B. Affidavit.

C. Submit documentation of tests, balancing reports, and the like.

1.4 INITIAL STARTUP AND OPERATION OF FACILITIES

A. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation; this general sequence shall apply to both the pump station and hydropneumatic tank:

1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 14 below.
2. Perform satisfactory testing of electrical work required prior to energizing of the electrical system.
3. After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
4. Complete calibration of instruments.
5. Satisfactorily complete system verification or instrumentation work.
6. After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
7. After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters.
8. Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested.
9. Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
10. Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
11. Repeat Steps 1 through 10 as required for other equipment items and systems until all process components and utility systems are ready for total operation.
12. Notify the Owner 30 days before facility operation is to occur so that the Owner may order chemicals and make other arrangements for full time operation. This notification shall have an accuracy of plus or minus 7 days. Notify the Owner exactly 7 days before system operation is to begin.
13. Upon completion of all the above steps, the facility shall be started up and operated on a complete full time basis beginning on the indicated date. The Owner will provide operating personnel and water. For three consecutive days beginning with the start-up day, the Contractor shall have at the site, during the day shift, a mechanic, an electrician, and an instrument engineer as determined to be needed by the Engineer. Representatives of manufacturers of critical equipment shall also be present for these five days as needed or as required elsewhere in the specifications. The Contractor shall also provide these personnel, on a 24-hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.
14. After successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation. If continuous process operation is interrupted for a period of four consecutive hours or more due to a failure of the

equipment or work provided by the Contractor, then the counting of the 5-day and/or 30-day periods, described in Step 13 above, shall be restarted at day one if these periods have not reached satisfactory completion.

15. Following the commencement of Step 13, satisfactorily complete equipment performance testing, electrical testing and adjustments, and instrumentation control testing and adjustments to the extent that such testing and adjustments could not be made prior to full plant operation.
16. Complete the documentation of test, balancing reports, and the like commissioning for submittal during the startup process and before acceptance.

1.5 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

A. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by an authorized factory-trained and qualified manufacturer's representative for the specific equipment. Equipment shall not be considered ready for full time operation until after the manufacturer's representative has checked and adjusted the equipment, and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation.

B. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.

1. Affidavits shall contain the following specific wording: "The [Name of Equipment] has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation. The installation has been inspected and has been found to be in conformance with our (the manufacturer's) standards and requirements."
2. No amplification, dilution, or modification of this specific wording will be permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01650

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Submittal Procedures" for submitting surveys.
3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Construction Manager that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Construction Manager promptly.

B. General: Engage a land surveyor lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Construction Manager when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

SECTION 01731
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety. **Miscellaneous elements include the following:**

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Equipment supports.
4. Piping, vessels, and equipment.

D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential

interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.
3. Exterior Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01731

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "General Conditions" Part 6 “Payments and Completion” for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
6. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
10. Complete final cleaning requirements, including touchup painting.
11. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "General Conditions" Part 6 “Payments and Completion.”
2. Submit certified copy of Engineer’s Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit one hard copy and one PDF copy of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Construction Manager.
    d. Name of Contractor.
    e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the O&M Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Clean each surface. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.
    f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    g. Remove labels that are not permanent.
    h. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

        1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

    i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    j. Replace parts subject to unusual operating conditions.
    k. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    l. Leave Project clean.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 01781

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:

1. Division 1 Section "Contract Closeout" for general closeout procedures.
2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit two set(s) of marked-up Record Prints.

B. Record Product Data: Submit three copies of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Locations of concealed internal utilities.
    i. Changes made by Change Order or Construction Change Directive.
    j. Changes made following Architect's written orders.
    k. Details not on the original Contract Drawings.
    l. Field records for variable and concealed conditions.
    m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Construction Manager's reference during normal working hours.

END OF SECTION 01781

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation manuals for systems, subsystems, and equipment.
2. Maintenance manuals for the care and maintenance of systems and equipment.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit two draft copies of each manual at least **15** days before requesting inspection for Substantial Completion. Provide a Mechanical Manual and a Controls/Electrical Manual for each pump station. Include a complete Table of Contents. Construction Manager will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit four of each manual in final form at least five days before final inspection. A separate manual is required for each pump station. Engineer will return copy with comments within five days after final inspection.

1. Correct or modify each manual to comply with Engineer's comments. Correct manuals within 5 days of receipt of Engineer's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents.

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY SECTION

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION SECTION

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE SECTION

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE SECTION

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Start-up Documentation: Provide factory startup documentation.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a

tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 01820

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for requirements for pre-construction conferences.
2. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training: Develop a learning objective and teaching outline, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project Record Documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.

b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Construction Manager, with at least 10 days' advance notice.

END OF SECTION 01820

SECTION 02050

DEMOLITION

PART 1 GENERAL

1.1 - DESCRIPTION

A. Provide all demolition required to perform the work covered under this contract including without limitation:
   1. Remove and dispose of existing equipment, piping, valves, and other appurtenances as indicated on the Drawings and as specified herein.
   2. Remove and replace existing construction as required to provide access to perform other work included in this contract.
   3. Include removal of mechanical and electrical work that is to be abandoned and is contained in construction to be removed whether or not the mechanical and electrical work is shown. Disconnect and cap off utilities in accordance with applicable codes and safety regulations.
   4. Where utilities that are not shown pass through construction that must be removed and those utilities serve other areas notify the Owner before disrupting service. If rerouting is required to maintain service, the Owner may issue a Change Order to accomplish the required work.
   5. Store and protect items intended for reuse.
   6. Assume ownership of debris and unwanted materials, remove from the site, and dispose of legally.
   7. Include the cost of removing and disposing of hazardous material including without limitation asbestos or asbestos-containing material, lead-containing paint, and PCBs. If the presence of hazardous materials is suspected, notify Owner. If material is identified as hazardous, retain qualified and licensed specialist to remove and dispose of it legally. Note that portions of this project involve work with asbestos-cement pipe.
   8. If illegal electrical wiring is encountered such as "BX" or non-metallic sheathed cable, notify the Owner.
   9. Remove unwanted fixed equipment and devices built into or attached to the building. Remove all loose items including rubbish, debris, furniture, etc.

B. Related Sections:

   1. Section 01010: Summary of Work and Contract Requirements
   2. Section 01040: Coordination and Project Requirements
   3. Section 01140: Environmental Protection

1.2 - NOISE AND DUST CONTROL

A. Refer to Section 01140.

1.3 - WARNING

A. The Contractor is advised that work under this Section may be hazardous. The Contractor is to take all necessary precautions to ensure the safety of workers and property.

Removal of, and/or working in areas containing even minor amounts of hazardous material including without limitation, asbestos, lead-based paint, PCBs or other hazardous materials requires special precautions, knowledge and procedures. Note that this project involves work with asbestos-cement pipe. If other hazardous material is suspected, notify the Owner.

B. Adequate means of safe, clear egress for the Owner and Owner's guests shall be maintained.

PART 2 - PRODUCTS

Not Used

PART 3 EXECUTION

3.1 - COORDINATION AND PHASING

A. Demolition shall be coordinated with the Owner, and proper advance notice shall be given for shutdowns as specified in Sections.

3.2 REMOVAL OF CONSTRUCTION DEBRIS AND EQUIPMENT

A. Prior to the removal of construction debris or equipment, the Contractor shall first investigate the location of all utility service pipelines, process pipelines, and electrical power and signal conductors which may be affected by the demolition and construction operations. The Contractor shall coordinate with the Owner to de-energize and isolate all utility and process pipelines and all electrical conductors, which may be affected.

B. The Contractor shall limit the extent of demolition to those features indicated on the Drawings to be demolished, except as noted herein. If the Contractor believes that removal and replacement of Features to Remain in Place will be required for completion of the Work, the Contactor shall include the cost of removal and replacement in the bid price. Prior to temporary removal of these features, the Contractor shall receive written approval from the Owner.

C. Remove structural work designated for removal. Take precautions not to damage structural work intended to remain. Where temporary shoring is needed, submit a design prepared by an appropriately licensed engineer for review before proceeding.

D. Equipment to be Disposed:

The following table designates equipment to be removed and disposed:

ITEM	DESCRIPTION
All demolition items not designated to remain in place.	No items are identified for salvage or reuse/relocation.

3.03 PROTECTION OF WORK TO REMAIN

A. Existing equipment, pipe work, foundations, instrumentation, electrical work, mechanical work, and other items located in the areas affected by the Work shall be reused, salvaged, left in place, or disposed of as designated in the specifications or indicated on the Drawings. The approximate locations of the equipment, which is to be reused or remain in place, are shown on the Drawings. Prior to the start of the Work, the Owner will place tags on equipment to be salvaged, which will identify the equipment and designate the onsite storage location. The Owner reserves the right to re-designate "equipment to be disposed" as "equipment to be salvaged/recycled" at no additional cost to the Owner during the progress of the Work.

B. Features to be Reused/Relocated: The Owner does not wish to reuse any equipment.

C. Features to be Salvaged: The Owner does not wish to salvage any equipment.

3.04 PROTECTION OF WORK TO REMAIN

A Protect all work to remain. Repair damage with materials, workmanship, and finishes matching existing work when new.

B. Protect existing construction to remain with temporary coverings.

C. Protect mechanical and electrical work that serves other areas. Coordinate with Owner and relocate mechanical and electrical work that is required to preserve service to other areas.

D. If structural elements are encountered that were not shown, protect them from damage, and report their presence to the Owner.

E. Conductors to be abandoned shall be removed or cut off and the conduits properly sealed.

F. Pipelines and conductors to remain in service shall be protected and properly supported during demolition operations until they can be incorporated into the new construction. Protect open ends of pipelines and conduits to prevent entry of foreign objects.

3.05 IF HAZARDOUS MATERIALS ARE ENCOUNTERED

A. This project involves work with asbestos-cement. If other hazardous materials are discovered, comply with paragraph 1.01 of this Section and all applicable laws.

3.06 REMOVAL AND DISPOSAL OF MATERIAL

A. Store debris in suitable covered containers located where directed by the Owner and remove from site when full. Burning on the site is not permitted.

B. Removed material shall become the property of the Contractor who shall remove it from the site and dispose of it in a legal manner.

END OF SECTION 02050

SECTION 02230

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:
   1. Clear the site of all vegetation, top soil, et cetera as required for the construction. Dispose of all spoils at an agreed upon off site location.
   2. Protect all vegetation, buildings, materials, paving, et cetera to remain.
   3. Where utilities are to be disconnected or removed, cap and seal at the limits of the work. Where utilities are to remain, protect and insure that they remaining in working order.
   4. Provide temporary erosion- and sedimentation-control measures. These measures must meet owner, local, state, and federal requirements for this site.

B. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.2 DEFINITIONS

Definitions used are those in common usage in the construction industry. Where in doubt or there is a disagreement, the definition used in the American Public Works Association, 2012, Standard Specifications for Road, Bridge, and Municipal Construction shall be used.

1.3 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations. Retain paragraph below to suit Project.

B. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 2 Section "Earthwork."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain flag each tree trunk at 54” above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, in strict accordance with the requirements of all authorities having jurisdiction.

3.3 PLANT PROTECTION

A. General: Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, et cetera that are to remain and are damaged by construction operations, in a manner approved by the owner.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property or at a location approved by the owner on the owner’s property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 02230

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

2.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

B. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

C. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

END OF SECTION 02240

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Division 1
2. Division 2
3. Division 3
4. Division 15
5. Division 16

1.3 DEFINITIONS

A. Except as noted below, definitions used are those in common usage in the construction industry. Where in doubt or there is a disagreement, the definition used in the American Public Works Association, 2012, Standard Specifications for Road, Bridge, and Municipal Construction shall be used

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
1. Geotextiles.
2. Controlled low-strength concrete and insulation materials.
3. Warning tapes.

B. Material Test Reports: For each material proposed for fill:
1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

1.5 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property:
   1. Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   2. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Locate all utilities before proceeding with any digging and excavation. Protect all buried utilities except where scheduled for removal or replacement.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, are in place.

E. Do not commence earth moving operations until plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. shall be free of debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100% passing a 1-1/2-inch sieve and not more than 10 percent passing a No. 200 sieve.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100% passing a 1-inch sieve and not more than 5 percent passing a No. 200 sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100% passing a 1-1/2-inch sieve and not more than 5% passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Sand: ASTM C 33; fine aggregate.

2.2 GEOTEXTILES

A. Geotextile fabrics shall be manufactured and suitable for the purpose intended in the drawings. All geotextiles are subject to review and approval by the engineer of record.

2.3 IN-GROUND INSULATION MATERIALS

A. Extruded-Polystyrene Board Insulation: ASTM C 578, **Type X, 1.30-lb/cu. ft. density, 15-psi compressive strength**

B. Other Polystyrene insulation may be substituted with the approval of the engineer. Such insulation must meet the performance and strength characteristics noted on the plans and above.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is **buried up to 30 inches deep; colored as follows:**

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. Conform to all local, state, federal, and other safety requirements. All excavation work shall conform to the best practices for such work.

B. All excavated materials not meeting the requirements of the fill and backfill materials noted above shall be disposed of offsite at a location approved by the owner.

C. Building Excavation:
1. Excavate around the building from the surface down to hard mineral (gravel, sandy gravel, hard pan, or a similar material with a bearing capacity in excess of 4,000 pounds per square foot) or down to bedrock.
2. The minimum size of the excavation shall be the size of the building plus four feet in every direction.
3. Note that insulation materials will extend beyond this four foot minimum and the upper parts of the excavation will need to be sized and backfilled to accommodate the insulation.

D. Utility and other excavations: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. Retain paragraph below if required.

C. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

C. Clearance: **12 inches each side of pipe or conduit**.

D. Trench Bottoms:
1. Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

2. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If the Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 1000 psi may be used in lieu of extending the bottom of the footing.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.8 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Placement and compaction:
1. Except where noted, placement and compaction shall conform to this subsection.
2. Place fill in 12 inch *maximum loose lifts.*
3. Compact using approved compaction equipment to 95% of ASTM D1557. All compacted materials shall have a hard and unyielding surface at the end of the compaction.
4. If the contractor is unable to compact the 12 inch thick loose lifts to the required density, compact using 6 inch or 4 inch thick loose lifts.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 24 inches of bottom of footings with structural backfill compacted to 95% of ASTM D1557.

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of free of particles larger than **1 inch** in any dimension, to a height of 12 inches over the pipe or conduit. Hand compact the initial fill using hand operated equipment taking care not to damage the pipes or conduit.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Install warning tape directly above utilities, 24 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

B. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

C. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

1. Dispose of all surplus, waste, et cetera, a location acceptable to the owner.

END OF SECTION 02300

PORT GRAHAM BIOMASS FACILITY

SECTION 15010

MECHANICAL PROVISIONS

1. GENERAL

a. WORK INCLUDED

i. Work includes complete mechanical systems shown on the plans and specified.
ii. The Bid and Contract Documents and General Requirements of the specification are a part of this division of the specification.
iii. Provide supervision, labor, material, equipment, machinery and plant necessary to complete the mechanical systems.
iv. Provide finished work, tested and ready for operation. Where the word "provide" is used, it means "furnish and install complete and ready for use". See Section 01011 for definitions.

b. DRAWINGS

i. Drawings are diagrammatic, indicating the general arrangement of systems and work, and do not attempt to show exact details or all offsets in piping and ductwork. Do not scale drawings. Examine the architectural drawings for exact location of fixtures and equipment. Where they are not definitely located, obtain this information from the Engineer.
ii. Follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom. If space conditions appear inadequate, notify the Engineer before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.

c. EQUIPMENT DEVIATIONS

i. Specific manufacturers and model numbers are noted to indicate a standard of design and not intended to be restrictive if noted as “or equal” or “or approved equal”.
ii. Provide redesign to any part of the work resulting from the use of equipment and material other than specified or shown on the drawings. Obtain approval of redesign from the Engineer. Redesign cost and additional construction cost resulting from the redesign shall be at the Contractor's expense.

d. SHOP DRAWING AND SUBMITTALS DATA

i. Check and verify field measurements and requirements. Submit promptly, so as not to delay the work, checked and approved by the Contractor, of all shop drawings and submittals data listed below. The Engineer will check and review with reasonable promptness the shop drawings and submittals data only for conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Make corrections required by the Engineer and re-submit corrected copies to Engineer. The Engineer's review of the shop drawings and submittals data shall not relieve the Contractor from responsibilities for deviation from the Contract Documents unless the Contractor has in writing called to the Engineer's attention deviation at the time of submission and secured the Engineer's written approval, nor shall it relieve the Contractor from responsibility for errors in the shop drawings and submittals data.

ii. The shop drawings and submittals data for the material and equipment listed below shall be submitted at one time. Each copy shall be in a binder, indexed, properly labeled indicating specific material or equipment for which it is to be used and the specification section and paragraph number relating to the submitted item.

iii. Review, approve and stamp shop drawings and submittals data before submission to the Engineer. Notify the Engineer in writing of any deviation from the requirements of the Contract Documents.

iv. Failure to submit shop drawings and submittals data in ample time for checking and review shall not entitle the Contractor to an extension of contract time.

v. Submit shop drawings and submittals data on the following equipment:

(1) Equipment installation in penthouses, on rooftop, and interior spaces.

(2) Should include, but not be limited to, air handling equipment, cooling towers, controls, chillers, pumps, piping, hangers, duct materials and fittings, insulation, louvers, etc.

e. CODES AND STANDARDS

i. Give necessary notices, obtain permits and pay taxes, fees and other costs, including utility connections or extensions for the work. File necessary plans, prepare documents and obtain necessary approvals of governmental departments having jurisdiction. Obtain required certificates of inspection for work and deliver to the Engineer before request for acceptance and final payment for the work.

ii. Comply with laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the work. If the Contractor observes that any of the Contract Documents are at variance therewith in

any respect, he shall promptly notify the Engineer in writing and any necessary changes shall be accomplished by appropriate modification. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to the Engineer, he shall assume full responsibility, and shall bear all costs.

iii. Material and equipment within the scope of the UL Testing Laboratory Service shall be listed by the Underwriters' Laboratories or other Nationally Recognized Testing Laboratory (NRTL), for the purpose for which they are used and shall bear their listing mark.

2. PRODUCTS: Not Used.

3. EXECUTION

a. COOPERATION WITH OTHER TRADES

i. Give full cooperation to other trades and furnish in writing to other trades, with copies to the Engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

ii. Where mechanical work will be installed in close proximity to, or will interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment.

(1) Prepare composite working drawings and sections at a suitable scale, not less than ¼" = 1'-0", clearly showing how the mechanical work is to be installed in relation to the work of other trades.

(2) If work is installed before coordinating with other trades, or if it causes any interference with work of other trades, make the necessary changes in the work to correct the conditions and bear all costs.

iii. Furnish to other trades necessary templates, patterns, setting plans and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

b. PROTECTION

i. Protect work and material from damage and be liable for damage.

ii. Be responsible for work and equipment until finally inspected, tested and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site which are not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign material.

c. SCAFFOLDING, RIGGING AND HOISTING

i. Provide ladders, scaffolding, rigging, hoisting, shoring, and services necessary for delivery into the premises and erection of any equipment and apparatus and execution for the work.
ii. Remove same from premises when no longer required.

d. MATERIAL AND WORKMANSHIP

i. Materials and equipment required for the work shall be new and shall be furnished, delivered, erected, installed, connected and finished in every detail; and shall be selected and arranged to fit properly into the building spaces. Where no specific kind or quality of material is given, an article as approved by the Engineer shall be provided.
ii. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work.
iii. Equipment and materials shall be installed with the approval of the Engineer in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

e. ACCESSIBILITY

i. Install the work with adequate clearances throughout the project, including being responsible for the sufficiency of the size of shafts, chases, double partitions and suspended ceilings. Cooperate with other trades where work is in the same space. Such spaces and clearances shall be kept to the minimum size required.
ii. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from drawings may be made to allow to better accessibility and any change shall be approved by the Engineer.
iii. The Mechanical Subcontractor shall provide the General Contractor the exact locations of access panels for each concealed valve, control, damper or other device requiring service. Access panels will be provided and installed by the General Contractor and as specified in the other divisions of the specifications. Submit locations of these panels in sufficient time to be installed in the normal course of work.

f. CONTROL WIRING

i. Install in conformance with current National Electrical Code and all requirements of controls specification.
ii. Provide all control wiring for controls requiring field installation. This

work shall include any necessary conduit, junction boxes, and similar miscellaneous equipment.

iii. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions.

g. ELECTRICAL CONNECTIONS

i. The Electrical Subcontractor shall provide wiring, except temperature control wiring, equipment control wiring and interlock wiring. The Electrical Subcontractor shall provide power wiring complete from power source to motor or equipment junction box, including power wiring through starters.

ii. Electrical Subcontractor shall provide starters and disconnect switches not factory mounted on equipment.

iii. The Mechanical Subcontractor shall, regardless of voltage, provide temperature control wiring, interlock wiring and equipment control wiring for the equipment that the Mechanical Subcontractor furnishes or installs.

iv. After circuits are energized and completed, the Electrical Subcontractor shall be responsible for power wiring. Control wiring shall be the responsibility to the Mechanical Subcontractor. Motors and equipment shall be provided for current characteristics as shown on the electrical drawings.

h. CUTTING AND PATCHING

i. Provide cutting and patching necessary to install the work specified in this division. Patching shall match adjacent surfaces.
ii. No structural members shall be cut without the approval of the Engineer, and cutting shall be done in a manner directed by him. Do not damage or endanger any portion of the project or work of the Owner or any other separate contractor by cutting, patching, excavating and backfilling.
iii. Inform the General Contractor and other subcontractors affected of requirements for cutting and patching.

i. TEMPORARY HEAT

i. The building heating system may be utilized as early as possible for temporary heat, following checkout and testing of the equipment and with the consent of the Engineer.
ii. Provide power to operate building heating equipment during construction period.
iii. Provide inlet air filters on building fan equipment and return duct openings used for temporary heat. Clean the equipment and replace filters before heating systems and the project are put into regular operation.

j. BOXES, SLEEVES, AND CHASES

i. Inform the General Contractor of requirements for boxes, sleeves, and chases. The General Contractor shall set boxes, sleeves, and chases. Furnish General Contractor with the boxes and sleeves and be responsible for informing General contractor of required location.

k. PROJECT RECORD DOCUMENTS

i. Drawings: Conform to the requirements of Sections 01011, 01300, and 01700.
ii. O & M Manuals: Conform to the requirements of Section 01730.
iii. Other Documents: Conform to the requirements of Sections 01300, and 01700.

l. CLEANING

i. Promptly remove waste material and rubbish caused by the work. At completion of the work, clean dirt and debris from the mechanical

installation, including equipment, piping, ductwork, and plumbing fixtures.

ii. Upon completion of the project and after cleaning is complete and before project is air balanced, provide clean air filters throughout.

m. WARRANTY

i. All work, material and equipment to be free from defects. Correct all defects and failures occurring within the warranty period without cost to the Owner except when such failure is due to neglect or carelessness by the Owner, as determined by the Engineer.

ii. Conform to Section 01700.

iii. The warranty disregards shorter time limits by an manufacturer of equipment provided.

iv. Make all necessary adjustments and corrections during first year of operation.

v. The fact that the Engineer, A/E, owner, or inspection was present during any construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.

END OF SECTION 15010

SECTION 15090

MECHANICAL SUPPORTING DEVICES

1. GENERAL

   a. WORK INCLUDED

      i. Expansion devices.
      ii. Equipment bases and supports.
      iii. Seismic bracing to meet local seismic zone.

2. PRODUCTS

   a. ACCEPTABLE MANUFACTURERS
      i. Adsco,
      ii. Advance Thermal Systems,
      iii. ITT-Grinnel,
      iv. Keflex,
      v. Aeroquip-Barco, or
      vi. approved substitute.

   b. STRUCTURAL ATTACHMENTS

      i. Steel Structural Clamps: Beam clamps, brackets, channel clamps, and bar joist clips select to suit structural system and meet loading recommendations of manufacturer.
      ii. Ceiling Inserts:
         (1) 3" and smaller pipe, Grinnell Fig. 285, or equal.
         (2) 3-½ " and larger pipe, Grinnell Fig. 281, or equal.
         (3) Multiple pipes on trapeze, Grinnell Fig. 285 or Fig. 281, (or equal) selected for maximum weight of piping.
      iii. Wall Inserts:
         (1) Unistrut P-3200 series (or equal) inserts for concrete walls.
         (2) Unistrut P-1800 series (or equal) inserts for brick walls.
         (3) Unistrut P-1000 channels with P-1045 and P-1047 (or equal) fittings for frame and block walls.
      iv. Attachment into existing concrete or masonry wall:
         (1) Self-drill type Red Head, Phillips Anchors (or equal). Do not use Power drive inserts.

   c. INTERMEDIATE ATTACHMENTS

      i. Trapeze Pipe Racks: Fabricate from structural angles, channels, or Unistrut (or equal) channels to weight of piping to be supported.

ii. Size for a minimum safety factor of 5.

d. PIPE ATTACHMENTS

i. Pipe Rings:
(1) Steel pipe and cast iron soil pipe:
(a) 2" and smaller, adjustable ring Grinnell #269 (or equal).
(b) 2-½ " and larger, adjustable clevis Grinnel #260 (or equal).
(2) Copper Pipe:
(a) 2" and smaller, adjustable ring Grinnell #CT-269 (or equal).
(b) 2 ½" and larger, adjustable clevis Grinnel #CT-65 (or equal).
(3) Glass pipe and plastic pipe:
(a) Same as steel pipe above except plastic coated.
(4) Finish:
(a) Black for black steel pipe and cast iron pipe;
(b) Galvanized for galvanized steel pipe;
(c) Copper plated for copper pipe.
(d) Plastic coated for plastic and glass pipe.
(5) Application:
(a) Use only on piping systems where axial movement from thermal expansion is less than ½ ".

ii. Pipe Rolls:
(1) Suspended pipe: Adjustable clevis pipe rolls, Grinnell Fig. 181 (or equal).
(2) Racked pipe: Pipe roll stand, Grinnell Fig. 271 (or equal).
(3) Application: Use on piping systems where axial movement from thermal expansion is ½ " or greater.

iii. Pipe Clamps:
(1) Vertical piping.
(a) Unistrut P-1332 shelf bracket, Unistrut P-1100 channel and Unistrut P-110 series pipe clamps (or equal).
(b) Copper pipe clamps for copper pipe.
(2) Horizontal racked piping: Unistrut P-1109 series or Unistrut P-2024C series clamps for Unistrut channel pipe racks (or equal).
(3) Application: Use on piping systems without any thermal expansion.

iv. Continuous Support: ½ " through 4" Fee & Mason #109 channels with Fee & Mason #108 hanger (or equal).

v. Pipe Anchors:
(1) Structural steel with welded joints and connections, unless shown otherwise on drawings.
(2) Pipe guides for steel pipe Adsco Model "FRE"(or equal), with 7" guide traverse, unless indicated otherwise on the drawings.
(3) Pipe guides for copper pipe Adsco Model "FRE"(or equal), with

copper shields and with 6" guide traverse, unless indicated otherwise on the drawings.

(4) Insulating thermal barrier at pipe guides used on chilled water piping, Adsco "ITB"(or equal). Insulate screw heads to avoid condensation.

vi. Vertical Pipe Supports:

(1) Steel and iron pipe: Grinnell #261 galvanized (or equal).

(2) Plastic pipe: Grinnell #261C (or equal).

END OF SECTION 15090

SECTION 15135

GAGES AND METERS

1. GENERAL

a. SECTION INCLUDES

i. Flow meters.
ii. Pressure gages and Pressure gage taps.
iii. Thermometers and thermometer wells.
iv. Static pressure gages.
v. Filter gages.

b. SUBMITTALS

i. Section 01300 - Submittals.
ii. Product Data: Provide cut sheets which indicate use, operating range, total range and location for manufactured components.
iii. Operation and Maintenance Data and Manuals — Conform to the requirements of Section 01730.
iv. Project Record Documents: Record actual locations of components and instrumentation.

c. ENVIRONMENTAL REQUIREMENTS

i. Section 01600 - Material and Equipment: Environmental conditions affecting products on site.
ii. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

d. EXTRA MATERIALS

i. Section 01700 - Contract Closeout.
ii. Provide two bottles of red gage oil for static pressure gages.
iii. Provide two each of spare pressure gages with pulsation damper and dial thermometers.

2. PRODUCTS

a. LIQUID FLOW METERS

i. ASME MFC-3M, calibrated venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gage in case.
ii. Measuring Station: Type 316 stainless steel Pitot type flow element

installed in threaded nipple pipe section, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.

(1) Pressure rating: 275 psig (1896 kPa).
(2) Maximum temperature: 400 degrees F (204 degrees C).
(3) Accuracy: Plus 0.55 percent to minus 2.30 percent.

iii. Portable Meter Set: Dry single diaphragm type pressure gage with 6 inch (150 mm) dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve, two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot (3 m) long rubber test hoses with brass valves or quick connections for measuring stations.

b. PRESSURE GAGES

i. Manufacturer: Marsh or equal.
ii. Gage:
(1) ASME B40.1, drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
(2) Case: Cast aluminum with phosphor bronze bourdon tube.
(3) Size: 2 inch (50 mm) - 6 inch (150 mm) diameter.
(4) Mid-Scale Accuracy: One percent.
(5) Scale: Both psi and kPa.

c. PRESSURE GAGE TAPPINGS

i. Gage Cock: Tee or lever handle, brass for maximum 150 psig (1034 kPa).
ii. Needle Valve: Brass, ¼ inch (6 mm) NPT for minimum 150 psig (1034 kPa).
iii. Pulsation Damper: Pressure snubber, brass with ¼ inch (6 mm) connections.
iv. Syphon: Steel, Schedule 40, ¼ inch (6 mm) angle or straight pattern.

d. STEM TYPE THERMOMETERS

i. Manufacturer: American or equal.
ii. Thermometer:
(1) ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.
(2) Size: 9 inch (225 mm) scale.
(3) Window: Clear glass.
(4) Stem: 3 inch brass minimum.
(5) Accuracy: 2 percent. Calibration: Both degrees F and degrees C.

e. DIAL THERMOMETERS

i. Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
(1) Size: 2-1/2 inch (60 mm) diameter dial.
(2) Lens: Clear glass.
(3) Accuracy: 1 percent.
(4) Calibration: Both degrees F and degrees C.

f. THERMOMETER SUPPORTS

i. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
ii. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

g. TEST PLUGS

i. Manufacturer: Peterson Equipment Company or equal.
ii. Test Plug: ¼ inch (6 mm) or ½ inch (13 mm) brass fitting and cap for receiving _ inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F (176 degrees C).
iii. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gages, one gauge adapters with _ inch (3 mm) probes, two 1-1/2 inch (38 mm) dial thermometers.

h. STATIC PRESSURE GAGES

i. Manufacturer: Marsh or equal.
ii. 3-1/2 inch (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front calibration adjustment, 2 percent of full scale accuracy.
iii. Inclined manometer, red liquid on white background with black figures, front calibration adjustment, 3 percent of full scale accuracy.

iv. Accessories: Static pressure tips with compression fittings for bulkhead mounting, ¼ inch (6 mm) diameter tubing.

3. EXECUTION

a. INSTALLATION

i. Install in accordance with manufacturer's instructions.
ii. Provide one pressure gage per pump, installing taps before strainers and

on suction and discharge of pump. Pipe to gage.

iii. Install pressure gages with pulsation dampers. Provide needle valve to isolate each gage. Extend nipples to allow clearance from insulation.

iv. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

v. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 15975. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

vi. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.

vii. Coil and conceal excess capillary on remote element instruments.

viii. Provide instruments with scale ranges selected according to service with largest appropriate scale.

ix. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

x. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

xi. Locate test plugs adjacent to control device sockets and pressure gages.

b. LOCATION SCHEDULES

i. Flow Meter Schedule

ii. ` None

iii. Pressure Gage Schedule
   (1) Pumps
   (2) Expansion tanks.

iv. Pressure Gage Tapping Schedule
   (1) Control valves ¾ inch (20 mm) & larger - inlets and outlets
   (2) Air Handler Unit coils - inlets and outlets
   (3) Chiller - inlets and outlets
   (4) Boiler - inlets and outlets

v. Stem Type Thermometer Schedule
   (1) Headers to central equipment
   (2) Air Handler Unit coil banks - inlets and outlets
   (3) Boilers - inlets and outlets
   (4) Chiller - inlets and outlets
   (5) After major coils

vi. Thermometer Socket Schedule
   (1)
   (2) Control valves 1 inch (25 mm) & larger - inlets and outlets
   (3) Unit heaters - inlets and outlets

vii. Dial Thermometer Schedule
   (1) Each supply air zone
   (2) Outside air

(3) Mixed air

viii. Static Pressure and Filter Gage Schedule
(1) Built up filter banks
(2) Unitary filter sections
(3) Supply fan discharge

END OF SECTION 15135

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 GENERAL

a. SECTION INCLUDES

i. Pipe and equipment hangers and supports.
ii. Equipment bases and supports.
iii. Sleeves and seals.
iv. Flashing and sealing equipment and pipe stacks.

b. PRODUCTS

i. Supply of pipe, duct, and equipment supports.

c. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
iii. Product Data: Provide manufacturers catalog data including load capacity.
iv. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
v. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

d. REGULATORY REQUIREMENTS

i. Conform to applicable code for support of plumbing, gas, and hydronic piping.

2. PRODUCTS

a. PIPE HANGERS AND SUPPORTS

i. Manufacturers:
   (1) Grinnell.
   (2) Other acceptable manufacturers offering equivalent products.
      (a) Basic Engineering Inc..
      (b) B-line.
      (c) Michigan.
ii. Plumbing Piping - DWV:
   (1) Hangers for Pipe Sizes ½ to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.

(2) Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
(3) Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
(4) Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
(5) Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
(6) Vertical Support: Steel riser clamp.
(7) Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
(8) Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

iii. Plumbing Piping - Water:
(1) Hangers for Pipe Sizes ½ to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
(2) Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
(3) Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
(4) Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
(5) Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
(6) Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
(7) Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
(8) Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
(9) Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
(10) Vertical Support: Steel riser clamp.
(11) Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
(12) Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
(13) Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
(14) Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

iv. Hydronic Piping:
(1) Hangers for Pipe Sizes ½ to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
(2) Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.

(3) Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
(4) Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
(5) Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
(6) Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
(7) Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
(8) Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
(9) Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
(10) Vertical Support: Steel riser clamp.
(11) Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
(12) Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
(13) Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
(14) Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

b. ACCESSORIES & INSERTS

i. Hanger Rods: Mild steel threaded both ends.
ii. Insert Manufacturers: Grinnell or equal.
iii. Inserts shall be malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

c. FLASHING

i. Metal Flashing: 22 gauge (0.8 mm thick) galvanized steel.
ii. Metal Counter Flashing: 22 gauge (0.8 mm thick) galvanized steel.
iii. Lead Flashing:
(1) Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
(2) Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.
iv. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

d. SLEEVES

i. Manufacturers: Miracle or equal.
ii. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel.
iii. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm thick) galvanized steel.
iv. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed .
v. Sleeves for Round Ductwork: Galvanized steel.
vi. Sleeves for Rectangular Ductwork: Galvanized steel.
vii. Insulation: Glass fiber type, non-combustible.
viii. Sealant: Acrylic.

3. EXECUTION

a. INSTALLATION

i. Install in accordance with manufacturer's instructions.

b. INSERTS

i. Provide inserts for placement in concrete form work.
ii. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
iii. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
iv. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
v. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

c. PIPE HANGERS AND SUPPORTS

i. Support horizontal piping as scheduled.
ii. Install hangers to provide minimum ½ inch (13 mm) space between finished covering and adjacent work.
iii. Place hangers within 12 inches (300 mm) of each horizontal elbow.
iv. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
v. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.
vi. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

vii. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
viii. Support riser piping independently of connected horizontal piping.
ix. Provide copper plated hangers and supports for copper piping.
x. Design hangers for pipe movement without disengagement of supported pipe.
xi. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

d. EQUIPMENT BASES AND SUPPORTS

i. Provide housekeeping pads of concrete, minimum 4 inches (100 mm) thick and extending at least 6 inches (150 mm) beyond supported equipment. Refer to Section 03300.
ii. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
iii. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
iv. Provide rigid anchors for pipes after vibration isolation components are installed.

e. FLASHING

i. Provide flexible flashing and metal counter flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
ii. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked one inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counter flash, and seal.
iii. Flash floor drains in floors with topping over finished areas with lead, 10 inches (250 mm) clear on sides with minimum 36 x 36 inch (910 x 910 mm) sheet size. Fasten flashing to drain clamp device.
iv. Seal floor drains watertight to adjacent materials.
v. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
vi. Provide curbs for mechanical roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counter flash with sheet metal; seal watertight. Attach counter flashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
vii. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

f. SLEEVES

i. Set sleeves in position in form work. Provide reinforcing around sleeves.
ii. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
iii. Extend sleeves through floors one inch (25 mm) above finished floor level. Calk sleeves.
iv. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and calk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
v. Install chrome plated steel escutcheons at finished surfaces.

g. SCHEDULES

HANGER ROD		
PIPE SIZE {inches}	MAX. HANGER SPACING {feet, (m)}	DIAMETER {Inches, (mm) }
½ to 1-1/4	6.5 (2)	_ (9)
1-1/2 to 2	10 (3)	_ (9)
2-1/2 to 3	10 (3)	½ (13)
4 to 6	10 (3)	_ (15)
8 to 12	14 (4.25)	_ (22)
14 and Over	20 (6)	1 (25)
PVC (All Sizes)	6 (1.8)	_ (9)

END OF SECTION - 15140

SECTION 15170
MOTORS & CONTROLLERS

1. GENERAL

a. SECTION INCLUDES

i. Single phase electric motors.
ii. Three phase electric motors.
iii. Motor controllers.

b. RELATED SECTIONS

i. Section 16180 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

c. REFERENCES

i. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
ii. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
iii. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
iv. NEMA MG 1 - Motors and Generators.
v. NFPA 70 - National Electrical Code.

d. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
iii. Test Reports: Indicate test results verifying nominal efficiency and power factor for motors larger than 20 horsepower.
iv. Manufacturer’s Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

e. OPERATION AND MAINTENANCE DATA

i. Submit under provisions of Section 01700.
ii. Operation Data: Include instructions for safe operating procedures.
iii. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

f. QUALIFICATIONS

i. Manufacturer: Company specializing in manufacture of electric motors for the intended use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

g. REGULATORY REQUIREMENTS

i. Conform to NEC latest edition, NFPA 70 and local energy code.
ii. Products Requiring Electrical connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

h. DELIVERY, STORAGE, AND HANDLING

i. Deliver, store, protect and handle products to site under provisions of Section 01600.
ii. Protect motors and controllers stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering.

i. WARRANTY

i. Provide two year warranty under provisions of Section 01700.

2. PRODUCTS

a. MOTORS

i. Manufacturers
(1) U.S. Motors.
(2) Reliance.
(3) Toshiba.
(4) Substitutions: Under provisions of Section 01600.
ii. General Construction And Requirements
(1) Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
(2) Electrical Service:
(a) Motors ¾ HP and Smaller: 120 volts or 277 volts, single phase, 60 Hz (as scheduled on plans).
(b) Motors Larger than ¾ Horsepower: 230 volts, single phase, 60 Hz (as scheduled on plans).

(3) Type: Open drip-proof except where specifically noted otherwise.
(4) Motors: Design for continuous operation at 40 degrees C.
(5) Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor (1.15 min.), and motor enclosure type.
(6) Motors with frame sizes 184T and larger: Energy Efficient Type.Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
(7) Wiring Terminations:
(a) Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
(b) For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

iii. Single Phase Power - Split Phase Motors
(1) Starting Torque: Less than 150 percent of full load torque.
(2) Starting Current: Up to seven times full load current.
(3) Breakdown Torque: Approximately 200 percent of full load torque.
(4) Drip-proof Enclosure: class A (50 degrees C temperature rise) Insulation, NEMA Service Factor, pre-lubricated sleeve or ball bearings.
(5) Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

iv. Single Phase Power - Permanent-split Capacitor Motors
(1) Starting Torque: Exceeding one fourth of full load torque.
(2) Starting Current: Up to six times full load current.
(3) Multiple speed: Through tapped windings.
(4) Open Drip-proof or Enclosed Air Over enclosure: class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, automatic reset overload protector.

v. Single Phase Power - Capacitor Start Motors
(1) Starting Torque: three times full load torque.
(2) Starting Current: Less than five times full load current.
(3) Pull-up Torque: Up to 350 percent of full load torque.
(4) Breakdown Torque: Approximately 250 percent of full load torque.
(5) Motors: Capacitor in series with starting winding; provide

capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

(6) Drip-proof enclosure: class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated ball bearings.

(7) Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

vi. Three Phase Power - Squirrel Cage Motors

(1) Starting Torque: between 1 and 1-1/2 times full load torque.

(2) Starting Current: Six times full load current.

(3) Power Output, Locked Rotor Torque, Breakdown or Pull Out torque: NEMA design B characteristics.

(4) Design, Construction, Testing, and Performance: conform to NEMA MG 1 for design B motors.

(5) Insulation System: NEMA Class B or better.

(6) Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

(7) Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

(8) Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 16483 - Motor Starters.

(9) Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

(10) Sound Power Levels: To NEMA MG 1.

(11) Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

(12) Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

(13) Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

(14) Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

b. MOTOR CONTROLLERS

i. Manufacturers
(1) ABB
(2) Cutler Hammer
(3) General Electric
(4) Graham VLT 3500 Series (VFD)

ii. General Construction And Requirements
(1) Motors and controllers shall be matched for their intended use. Contractor shall be responsible for coordination of motor and controller.
(2) Wye-delta and variable frequency drives must have motors designed for this use. Contractor is responsible for coordination of motor and starter.
(3) Name Plates:
(a) Provide engraved phenolic name plates per section 16195, permanently attached (with mechanical fasteners) on each controller with the following information:
(i) Source load and area served
(ii) Voltage and phase
(iii) Fuse size and type (when applicable)
(4) Fan Shut Down Relays:
(a) Provide relays with sufficient contacts to shut down all fans over 2000 cfm upon receipt of fire alarm.
(b) Provide smoke dampers in supply and returns to all air handlers larger than 2000 cfm.
(c) Coordinate relay coil voltage with the existing fire alarm and detection system.
(5) Enclosure:
(a) All motor controllers shall be contained in an enclosure suitable for the environment in which the controller is mounted, per NEC requirements.
(b) NEMA 3R minimum when exposed to weather.
(6) Accessories: In addition to all other requirements stated herein controllers shall include:
(a) “Manual-Off-Auto” selector
(b) Red Running Pilot Light
(c) Green off Pilot Light

(d) Control Transformer (Except for 115v Motors) with Fused Primary and Secondary
(e) Two Spare Auxiliary Contacts.

iii. Magnetic Motor Starters
(1) Shall be full voltage non-reversing for NEMA size 3 and under.
(2) No starters shall be smaller than NEMA size 0 and no half size starters are permitted.

iv. Variable Frequency Drive (VFD)
(1) Conform to NEMA ICA 3.1.
(2) Convert three phase, 60Hz utility power to variable voltage/frequency, three phase AC power for stepless motor control from 5% to 105% of base speed using transistorized sine-coded, pulse width modulated (PWM) technology.
(3) Provide input power factor near unity over the entire speed range.
(4) Shall not induce voltage line notching and shall not produce excessive or objectionable acoustical noise back to the power source.
(5) Total harmonic distortion shall be equal to or less than allowed by IEEE 519, 1983 or the latest issue.
(6) Operating range 0-40°C.

v. Overload Devices
(1) Single phase controllers:
(a) Shall be melting alloy or bimetallic type.
(b) Provisions shall be made for resetting the load devices from the outside of the enclosure.
(c) Provide ambient compensated overload devices only when the motor is at constant temperature and the controller is subject to a separate, varying temperature.
(d) Automatic reset overload devices are not permitted.
(2) Multi-phase controllers:
(a) Provide solid state overload relays for all multi-phase motors.
(b) Provide a remote reset module.
(c) Solid state relays shall provide protection for loss of phase and phase imbalance and include an LED indicator.

vi. Combination Motor Starters
(1) Fused switch type (class RK5), or motor circuit protector type rated for 22,000 RMS AIC unless noted otherwise.
(2) Switch or protector shall be capable of being padlocked in the “Off” position

vii. Manual Starters
(1) Toggle type switch.

(2) Lockable in the "Off" position.
(3) Complete with overload relays and pilot light.

3. EXECUTION

a. APPLICATION

i. Single phase motors for centrifugal pumps: Split phase type.
ii. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
iii. Single phase motors for fans, pumps, blowers, air compressors: Capacitor start type.
iv. Motors located in roll filters: Permanent split capacitor type.
v. Motors located in outdoors draw thru cooling towers: Totally enclosed weatherproof epoxy-sealed type.

b. INSTALLATION

i. Install in accordance with manufacturer's instructions.
ii. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
iii. Check line voltage and phase and ensure agreement with nameplate.
iv. Mechanical Contractor to provide motor with appropriate motor starter to site. Electrical Contractor will install motor starter and is responsible for all wiring.

c. NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.3 5	1.35	1.35
½	1.25	1.25	1.25	1.15
¾	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

d. PERFORMANCE SCHEDULE: THREE PHASE - ENERGY EFFICIENT, OPEN DRIP-PROOF

HP	1200 RPM (Syn)			1800 RPM (Syn)			3600 RPM (Syn)		
	NEMA Frame	Minimum Efficiency (%)	Min Power Factor (%)	NEMA Frame	Min Efficiency (%)	Min Power Factor (%)	NEMA Frame	Min Efficiency (%)	Min Power Factor (%)
1	145T	81	72	143T	82.5	84	-	-	-
1.5	482T	84	73	145T	84	85	143T	82.5	85
2	184T	85.5	75	145T	84	85	143T	84	87
3	213T	86.5	60	182T	86.5	86	145T	84	85
5	215T	87.5	65	184T	87.5	87	182T	85.5	86
7.5	254T	89	73	213T	88.5	86	184T	87.5	88
10	256T	90.2	74	215T	89.5	85	213T	88.5	86
15	284T	90.2	77	256T	91	85	215T	89.5	89
20	286T	91	78	256T	91	86	254T	90.2	89
25	324T	91.7	74	284T	91.7	85	256T	91	92
30	326T	92.4	78	286T	92.4	88	284T	91	91
40	364T	93	77	324T	93	83	286T	92	92
50	365T	93	79	326T	93	85	324T	93	89
60	404T	93.6	82	364T	93.6	88	326T	93	91
75	405T	93.6	80	365T	94.1	88	364T	93	88
100	444T	94.1	80	404T	94.1	83	365T	93	88
125	444T	94.1	84	405T	94.5	85	-	-	-
150	-	-	-	444T	95	85	-	-	-
200	-	-	-	445T	95	85	-	-	-

e. PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	1200 RPM (Syn)			1800 RPM (Syn)			3600 RPM (Syn)		
	NEMA Frame	Minimum Efficiency (%)	Min Power Factor (%)	NEMA Frame	Min Efficiency (%)	Min Power Factor (%)	NEMA Frame	Min Efficiency (%)	Min Power Factor (%)
1	145T	81	72	143T	82.5	84	-	-	-
1.5	182T	85.5	65	145T	84	85	143T	82.5	85
2	184T	86.5	68	145T	84	85	145T	84	87
3	213T	82.5	63	182T	87.5	83	182T	85.5	87
5	215T	87.5	66	184T	88	83	184T	87.5	88
7.5	254T	89.5	68	213T	89.5	85	213T	88.5	86
10	256T	89.5	75	215T	90	84	215T	89.5	86
15	284T	90.2	72	254T	91	86	254T	90.2	91
20	286T	90.2	76	256T	91	85	256T	90.2	89
25	324T	91.7	71	284T	92.5	84	284T	91	92
30	326T	91.7	79	286T	93	86	286T	91	92
40	364T	93	78	324T	93	83	324T	91.7	91
50	365T	93	81	326T	93	85	326T	92.4	92
60	404T	93.6	83	364T	93.6	87	364T	93	93
75	405T	93.6	80	365T	94.1	87	365T	93	91
100	444T	94.1	83	405T	94.5	86	405T	93.6	92
125	444T	94.1	85	444T	94.5	87	-	-	-
150	-	-	-	445T	95	88	-	-	-
200	-	-	-	147T	95	87	-	-	-

END OF SECTION 15170

SECTION 15190

MECHANICAL IDENTIFICATION

1. GENERAL

   a. SECTION INCLUDES

      i. Nameplates.
      ii. Tags.
      iii. Stencils.
      iv. Pipe Markers.

   b. REFERENCES

      i. ASME A13.1 - Scheme for the Identification of Piping Systems.

   c. SUBMITTALS

      i. Submit under provisions of Section 01300.
      ii. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
      iii. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
      iv. Product Data: Provide manufacturers catalog literature for each product required.
      v. Samples: Submit two each of labels and tags, 2 x 4 inch in size.
      vi. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
      vii. Submit “As Built Drawings” under provisions of Section 01700.
      viii. Record actual locations of tagged valves.

2. PRODUCTS

   a. NAMEPLATES

      i. Manufacturers: Seton or equal
      ii. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

   b. TAGS

      i. Manufacturers: Seton or equal.
      ii. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) square.

c. STENCILS

i. Manufacturers: Seton or equal.
ii. Stencils: With clean cut symbols and letters of following size:
(1) ¾ to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, ½ inch (15 mm) high letters.
(2) 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, ¾ inch (20 mm) high letters.
(3) 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
(4) 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
(5) Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
(6) Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.
iii. Stencil Paint: As specified in Section 09900, semi- gloss enamel, colors conforming to ASME A13.1.

d. PIPE MARKERS

i. Manufacturers:
(1) Seton or equal.
ii. Color: Conform to ASME A13.1.
iii. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
iv. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
v. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

e. CEILING TACKS

i. Manufacturers:
(1) Seton or equal.
ii. Description: Steel with ¾ inch (20 mm) diameter color coded head.
iii. Color code as follows:
(1) Yellow - HVAC equipment
(2) Red - Fire dampers/smoke dampers
(3) Green - Plumbing valves
(4) Blue - Heating/cooling valves

3. EXECUTION

a. PREPARATION

i. Degrease and clean surfaces to receive adhesive for identification materials.
ii. Prepare surfaces in accordance with Section 09900 for stencil painting.

b. INSTALLATION

i. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
ii. Install tags with corrosion resistant chain.
iii. Apply stencil painting in accordance with Section 09900.
iv. Install plastic pipe markers in accordance with manufacturer's instructions.
v. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
vi. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
vii. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags. Use stainless steel screws to attach signs.
viii. Identify control panels and major control components outside panels with plastic nameplates.
ix. Identify thermostats relating to terminal boxes or valves with nameplates.
x. Identify valves in main and branch piping with tags.
xi. Identify air terminal units and radiator valves with numbered tags.
xii. Tag automatic controls, instruments, and relays. Key to control schematic.
xiii. Identify piping, concealed or exposed, with stenciled painting on piping 1 inch diameter and larger, use tags on piping ¾ inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
xiv. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
xv. Provide ceiling tacks to locate VAV boxes, valves or dampers above T-bar type panel ceilings. Locate on ceiling grid (not on removable ceiling panels) in corner of panel closest to equipment.

END OF SECTION 15190

SECTION 15260

PIPING INSULATION

1. GENERAL

a. SECTION INCLUDES

i. Piping insulation.
ii. Jackets and accessories.

b. PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

i. Section 15510 - Hydronic Piping: Placement of hangers and hanger inserts.

c. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Product Data: Provide product description, list of materials and thickness for each service, and locations.
iii. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

d. QUALITY ASSURANCE

i. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with NFPA 255.

e. QUALIFICATIONS

i. Applicator: Company specializing in performing the work of this section with minimum three years experience.

f. DELIVERY, STORAGE, AND HANDLING

i. Deliver, store, protect, and handle products to site under provisions of Section 01600.
ii. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
iii. Store insulation in original wrapping and protect from weather and

construction traffic.

iv. Protect insulation against dirt, water, chemical, and mechanical damage.

g. ENVIRONMENTAL REQUIREMENTS

i. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

ii. Maintain temperature during and after installation for minimum period of 24 hours.

2. PRODUCTS

a. GLASS FIBER

i. Manufacturers:
(1) Manville Corp or equal.

ii. Insulation: ASTM C547; rigid molded, noncombustible.
(1) 'K' ('ksi') value : ASTM C335, 0.24 at 75 degrees F (0.035 at 24 degrees C).
(2) Minimum Service Temperature: -20 degrees F (-28.9 degrees C).
(3) Maximum Service Temperature: 300 degrees F (150 degrees C).
(4) Maximum Moisture Absorption: 0.2 percent by volume.

iii. Vapor Barrier Jacket
(1) ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
(2) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
(3) Secure with self sealing longitudinal laps and butt strips.
(4) Secure with outward clinch expanding staples and vapor barrier mastic.

iv. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.

v. Vapor Barrier Lap Adhesive
(1) Compatible with insulation.

vi. Insulating Cement/Mastic
(1) ASTM C195; hydraulic setting on mineral wool.

vii. Fibrous Glass Fabric
(1) Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
(2) Blanket: 1.0 lb/cu ft (16 kg/cu m) density.

viii. Indoor Vapor Barrier Finish: Vinyl emulsion type acrylic, compatible with insulation, white color.

ix. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic, compatible with insulation, white color.

x. Insulating Cement: ASTM C449.

b. CELLULAR GLASS

i. Manufacturers: Owens Corning or equal.
ii. Insulation:
(1) ASTM C552.
(2) 'K' ('ksi') value: 0.40 at 75 degrees F (0.058 at 24 degrees C).
(3) Maximum Water Vapor Transmission: 0.1 perm.

c. EXPANDED POLYSTYRENE INSULATION
i. ASTM C578; rigid closed cell.
ii. 'K' ('ksi') value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
iii. Maximum service temperature: 180 degrees F (82 degrees C).
iv. Maximum Water Vapor Transmission: 0.1 perm.

d. EXPANDED PERLITE INSULATION

i. ASTM C610; granular poured.
ii. 'K' ('ksi') value: 0.28 at 75 degrees F (0.04 at 24 degrees C).
iii. Maximum Water Vapor Transmission: 0.1 perm.

e. HYDROUS CALCIUM SILICATE INSULATION

i. ASTM C533; rigid molded white; asbestos free.
ii. 'K' ('ksi') value: ASTM C177 and C518; 0.44 at 300 degrees F (0.060 at 147 degrees C).
iii. Maximum Service Temperature: 1500 degrees F (815 degrees C).
iv. Density: 13 lb/cu ft (208 kg/cu m).
v. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.
vi. Insulating Cement: ASTM C449.

f. POLYURETHANE FOAM INSULATION

i. ASTM C591, rigid molded modified Polyisocyanurate cellular plastic.
ii. 'K' ('ksi') value: ASTM 518; 0.14 at 75 degrees F (0.020 at 24 degrees C).
iii. Minimum Service Temperature: -250 degrees F (-156 degrees C).
iv. Maximum Service Temperature: 250 degrees F (121 degrees C).
v. Maximum Moisture Absorption: ASTM D2842; 0.054 percent by volume.
vi. Moisture Vapor Transmission: 1.26 perm inches.
vii. Maximum Flame Spread: ASTM E84; 20.
viii. Connection: Waterproof vapor barrier adhesive.

g. POLYETHYLENE INSULATION

i. ASTM D1056 or D1667; flexible, closed cell, polyethylene, slit tubing.
ii. 'K' ('ksi') Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
iii. Minimum Service Temperature: -90 degrees F (-67 degrees C).
iv. Maximum Service Temperature: 212 degrees F (100 degrees C).
v. Density: ASTM 1667; 2 lb/cu ft (32 kg/cu m).
vi. Maximum Moisture Absorption: 1.0 percent by volume.
vii. Moisture Vapor Transmission: ASTM E96; 0.01 perm inches.
viii. Maximum Flame Spread: ASTM E84; 25.
ix. Maximum Smoke Developed: ASTM E84; 50.
x. Connection: Contact adhesive.

h. CELLULAR FOAM INSULATION

i. ASTM C534; flexible, cellular elastomeric, molded or sheet.
ii. 'K' ('ksi') Value: ASTM C177 or C518; 0.27 at 75 degrees F (0.04 at 24 degrees C).
iii. Minimum Service Temperature: -40 degrees F (-40 degrees C).
iv. Maximum Service Temperature: 220 degrees F (104 degrees C).
v. Maximum Moisture Absorption: ASTM D1056; 1.0 percent (pipe) by volume, 1.0 percent (sheet) by volume.
vi. Moisture Vapor Transmission: ASTM E96; 0.20 perm inches.
vii. Maximum Flame Spread: ASTM E84; 25.
viii. Maximum Smoke Developed: ASTM E84; 100.
ix. Connection: Waterproof vapor barrier adhesive.
x. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

i. JACKETS

i. PVC Plastic Jacket:
(1) ASTM C921, One piece molded type fitting covers and sheet material, off white color.
(2) Minimum Service Temperature: -40 degrees F (-40 degrees C).
(3) Maximum Service Temperature: 150 degrees F (66 degrees C).
(4) Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
(5) Maximum Flame Spread: ASTM E84; 25.
(6) Maximum Smoke Developed: ASTM E84; 100.
(7) Thickness: 15 mil.
(8) Connections: Pressure sensitive color matching vinyl tape.

(9) Covering Adhesive Mastic: Compatible with insulation.

ii. ABS Plastic Jacket:
(1) One piece molded type fitting covers and sheet material, off white color.
(2) Minimum Service Temperature: -40 degrees F (-40 degrees C).
(3) Maximum Service Temperature of 180 degrees F (82 degrees C).
(4) Moisture Vapor Transmission: ASTM E96; 0.012 perm inches.
(5) Thickness: 30 mil.
(6) Connections: Brush on welding adhesive.

iii. Canvas Jacket:
(1) UL listed
(2) Fabric: ASTM C921, 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
(3) Lagging Adhesive: Compatible with insulation.

iv. Aluminum Jacket:
(1) ASTM B209.
(2) Thickness: 0.016 inch (0.40 mm) sheet.

(3) Finish: Smooth.
(4) Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
(5) Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
(6) Metal Jacket Bands: _ inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

v. Stainless Steel Jacket: Type 304 stainless steel.
(1) Thickness: 0.010 inch (0.25 mm).
(2) Finish: Smooth.
(3) Metal Jacket Bands: _ inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

3. EXECUTION

a. EXAMINATION

i. Verify that piping has been tested before applying insulation materials.
ii. Verify that surfaces are clean, foreign material removed, and dry.

b. INSTALLATION

i. Install materials in accordance with manufacturer's instructions.
ii. On exposed piping, locate insulation and cover seams in least visible locations.
iii. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
(1) Provide vapor barrier jackets, factory applied or field applied.
(2) Insulate fittings, joints, and valves with insulation of like material and thickness as adjacent pipe. Insure that joints are fully filled with correct density material.
(3) Seal raw ends of field insulation with silicone type sealant at all fittings and elbows prior to installing the fitting insulation and jackets.
(4) Finish with glass cloth and vapor barrier adhesive.
(5) PVC fitting covers may be used.
(6) Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
(7) Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
iv. For insulated pipes conveying fluids above ambient temperature:
(1) Provide standard jackets, with or without vapor barrier, factory applied or field applied.
(2) Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
(3) Finish with glass cloth and adhesive.
(4) PVC fitting covers may be used.

(5) For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

(6) For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.

v. Inserts and Shields:

(1) Application: Piping 2 inches (50 mm) diameter or larger.

(2) Shields: Steel between pipe hangers or pipe hanger rolls and inserts.

(3) Insert Location: Between support shield and piping and under the finish jacket.

(4) Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

(5) Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

vi. Finish insulation at supports, protrusions, and interruptions.

vii. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet (3 meters) above finished floor, finish with canvas jacket sized for finish painting.

viii. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with stainless steel jacket with seams located on bottom side of horizontal piping and sealed with silicone sealant.

ix. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

x. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with stainless steel jacket with seams located on bottom side of horizontal piping.

c. TOLERANCE

i. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

d. GLASS FIBER INSULATION SCHEDULE

i. PIPING SYSTEMS

(1) Plumbing Systems

(a) Domestic Hot Water Supply

(b) Domestic Hot Water Recirculation
(c) Domestic Cold Water

(2) Heating Systems
(a) Heating Water Supply and Return
(b) Glycol Heating Supply and Return
(c) Boiler Feed Water

(3) Cooling Systems
(a) Chilled Water
(b) Condenser Water
(c) Glycol Cooling Supply and Return
(d) Refrigerant Suction
(e) Refrigerant Hot Gas

e. SCHEDULE OF SIZES

i. Conform to the following schedule:

MINIMUM PIPE INSULATION THICKNESS						
FLUID DESIGN OPERATING TEMPERATURE	Nominal Pipe Diameter (inches)					
	Run Outs ≤ 2"	≤ 1"	>1" ≤ 2"	>2" ≤ 4"	>4" ≤ 6"	>6"
Above 350° F	1.5	2.5	2.5	3.0	3.5	3.5
251° F to 350° F	1.5	2.0	2.5	2.5	3.5	3.5
201° F to 250° F	1.0	1.5	1.5	1.5	2.0	3.5
141° F to 200° F	0.5	1.5	1.5	1.5	1.5	1.5
105° F to 140° F	0.5	1.0	1.0	1.0	1.5	1.5
40° F to 104° F	0.5	0.5	.75	1.0	1.0	1.0
≤ 39° F	1.0	1.0	1.5	1.5	1.5	1.5

END OF SECTION 15260

SECTION 15280

EQUIPMENT INSULATION

1. GENERAL

   a. SECTION INCLUDES

      i. Equipment insulation.
      ii. Covering.
      iii. Breeching insulation.

   b. SUBMITTALS

      i. Submit under provisions of Section 01300.
      ii. Product Data: Provide product description, list of materials and thickness for equipment scheduled.
      iii. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

   c. QUALITY ASSURANCE
      i. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723.

   d. QUALIFICATIONS

      i. Applicator: Company specializing in performing the work of this section with minimum 5 years experience.

   e. DELIVERY, STORAGE, AND HANDLING

      i. Deliver, store, protect and handle products to site under provisions of Section 01600.
      ii. Deliver materials to site in original factory packaging, labeled with manufacturer's density and thickness.
      iii. Store insulation in original wrapping and protect from weather and construction traffic.
      iv. Protect insulation against dirt, water, chemical, and mechanical damage.

   f. ENVIRONMENTAL REQUIREMENTS

      i. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
      ii. Maintain temperature during and after installation for minimum period of 24 hours.

2. PRODUCTS

a. GLASS FIBER, FLEXIBLE

i. Insulation: ASTM C553; flexible, noncombustible.
(1) 'K' ('ksi') value : ASTM C335, 0.24 at 75 degrees F.
(2) Maximum service temperature: 250 degrees F.
(3) Maximum moisture absorption: 0.2 percent by volume.
(4) Density: 2.0 lb/cu ft density.

ii. Vapor Barrier Jacket
(1) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
(2) Moisture vapor transmission: ASTM E96; 0.04 perm.
(3) Secure with self sealing longitudinal laps and butt strips.
(4) Secure with outward clinch expanding staples and vapor barrier mastic.

iii. Tie Wire: 18 gage (1.2 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

iv. Vapor Barrier Lap Adhesive
(1) Compatible with insulation.

v. Insulating Cement/Mastic
(1) ASTM C195; hydraulic setting on mineral wool.

b. JACKETS

i. PVC Plastic
(1) Jacket: Sheet material, off white color.
(a) Minimum service temperature: -40 degrees F.
(b) Maximum service temperature: 150 degrees F.
(c) Moisture vapor transmission: ASTM E96; 0.002 perm inches.
(d) Maximum flame spread: ASTM E84; 25.
(e) Maximum smoke developed: ASTM E84; 50.
(f) Thickness: 15 mil.
(g) Connections: Brush on welding adhesive.
(2) Covering Adhesive Mastic
(a) Compatible with insulation.

ii. Canvas Jacket: UL listed
(1) Fabric: ASTM C921, 6 oz/sq yd (220 g/sq m), plain weave cotton treated with dilute fire retardant lagging adhesive.
(2) Lagging Adhesive
(a) Compatible with insulation.

iii. Aluminum Jacket: ASTM B209.
(1) Thickness: 0.020 inch sheet.
(2) Finish: Smooth.

(3) Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
(4) Metal Jacket Bands: _ inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

iv. Stainless Steel Jacket: Type 304 stainless steel.
(1) Thickness: 0.010 inch (0.25 mm).
(2) Finish: Smooth.
(3) Metal Jacket Bands: _ inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

3. EXECUTION

a. EXAMINATION
i. Verify that equipment has been tested before applying insulation materials.
ii. Verify that surfaces are clean, foreign material removed, and dry.

b. INSTALLATION
i. Install materials in accordance with manufacturer's instructions.
ii. Do not insulate factory insulated equipment.
iii. On exposed equipment, locate insulation and cover seams in least visible locations.
iv. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
v. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
vi. Insulated dual temperature equipment or cold equipment containing fluids below ambient temperature:
(1) Provide vapor barrier jackets, factory applied or field applied.
(2) Finish with glass cloth and vapor barrier adhesive.
(3) Insulate entire system.
vii. For insulated equipment containing fluids above ambient temperature:
(1) Provide standard jackets, with or without vapor barrier, factory applied or field applied.
(2) Finish with glass cloth and adhesive.
(3) For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
(4) For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
viii. Inserts and Shields:
(1) Application: equipment 2 inches diameter or larger.
(2) Shields: galvanized steel between hangers and inserts.
(3) Insert location: between support shield and equipment and under the finish jacket.
(4) Insert configuration: minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory

fabricated.

(5) Insert material: ASTM C640 cork or other heavy density insulating material suitable for the planned temperature range.

ix. Finish insulation at supports, protrusions, and interruptions.

x. For equipment in mechanical equipment rooms or in finished spaces, finish with canvas or PVC jacket and fitting covers.

xi. For exterior applications, provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

xii. Cover glass fiber insulation with aluminum jacket.

xiii. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

xiv. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that it can be easily removed and replaced without damage.

c. TOLERANCE

i. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

d. GLASS FIBER, FLEXIBLE INSULATION SCHEDULE

i. Heating System Equipment
   (1) Air Separators
   (2) Expansion Tanks

ii. Cooling System Equipment
   (1) Air Separators
   (2) Expansion Tanks
   (3) Chiller Cold Surfaces (Not Factory Insulated)

END OF SECTION 15280

SECTION 15510

HYDRONIC WOOD BOILER

1. GENERAL

a. SECTION INCLUDES

i. Pipe and pipe fittings for:
(1) Heating water piping system.
(2) Chilled water and condenser piping system.
(3) Equipment drains and overflows.

ii. Valves:
(1) Gate valves.
(2) Globe or angle valves.
(3) Ball valves.
(4) Plug valves.
(5) Butterfly valves.
(6) Check valves.

b. SYSTEM DESCRIPTION

i. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

ii. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

iii. Use non-conducting dielectric connections whenever jointing dissimilar metals.

iv. Provide pipe hangers and supports in accordance with ASTM B31.9 unless indicated otherwise.

v. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers on all lines less than or equal to 2-1/2” diameter and gate valves on all lines greater than 2-1/2” diameter.

vi. Use ball valves for throttling, bypass, or manual flow control services on all piping less than or equal to 2-1/2” diameter and globe valves on all piping greater than 2-1/2”.

vii. Use spring loaded check valves on discharge of all pumps.

viii. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

ix. Use butterfly valves in heating and chilled water systems interchangeably with gate and globe valves.
x. Use lug end butterfly valves to isolate equipment.
xi. Use ¾ inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

c. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
iii. Welders Certificate: Include welders certification of compliance with ASME SEC 9.
iv. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

d. PROJECT RECORD DOCUMENTS

i. Submit under provisions of Section 01700.
ii. Record actual locations of valves, pipes, and equipment.

e. OPERATION AND MAINTENANCE DATA

i. Submit under provisions of Section 01700.
ii. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

f. QUALIFICATIONS

i. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.
ii. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.
iii. Welders: Certify in accordance with ASME SEC 9.

g. REGULATORY REQUIREMENTS

i. Conform to ASME B31.9 code for installation of piping system.
ii. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

iii. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

h. DELIVERY, STORAGE, AND HANDLING

i. Deliver, store, protect and handle products to site under provisions of Section 01600.
ii. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
iii. Provide temporary protective coating on cast iron and steel valves.
iv. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
v. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

i. ENVIRONMENTAL REQUIREMENTS

i. Do not install underground piping when bedding is wet or frozen.

j. EXTRA MATERIALS

i. Furnish under provisions of Section 01700.
ii. Provide two repacking kits for each size and valve type.

2. PRODUCTS

a. HEATING WATER

i. Steel Pipe: ASTM A53, Schedule 40, 0.375 inch (10 mm) wall for sizes 12 inch (300 mm) and over, black.
(1) Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.
(2) Joints: Threaded, or AWS D1.1, welded.
ii. Copper Tubing: ASTM B88, Type L, hard drawn.
(1) Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
(2) Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

(3) Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F (220 to 280 degrees C) or Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 - 1480 degrees F (640 - 805 degrees C).

b. CHILLED WATER AND CONDENSER WATER PIPING

i. Steel Pipe: ASTM A53, Schedule 40, 0.375 inch (10 mm) wall for sizes 12 inch (300 mm) and over, black.
(1) Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type.
(2) Joints: Threaded or AWS D1.1 welded.

ii. Copper Tubing: ASTM B88, Type L, hard drawn.
(1) Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
(2) Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

(3) Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F (220 to 280 degrees C) or Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 - 1480 degrees F (640 - 805 degrees C).

iii. PVC Pipe: Not allowed.

c. EQUIPMENT DRAINS AND OVERFLOWS

i. Steel Pipe: ASTM A53, Schedule 40 galvanized.
(1) Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
(2) Joints: Threaded, or grooved mechanical couplings.

ii. Copper Tubing: ASTM B88, Type L, hard drawn.
(1) Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
(2) Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F (220 to 280 degrees C).

iii. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
(1) Fittings: ASTM D2466 or D2467, PVC.
(2) Joints: ASTM D2855, solvent weld.

iv. ABS Pipe: Not allowed.

d. PIPE HANGERS AND SUPPORTS

i. See Section 15140, Supports and Anchors

e. UNIONS, FLANGES, AND COUPLINGS

i. Unions for Pipe 2 Inches (50 mm) and Under:
(1) Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
(2) Copper Pipe: Bronze, soldered joints.

ii. Flanges for Pipe Over 2 Inches (50 mm):
(1) Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
(2) Copper Piping: Bronze.
(3) Gaskets: $^{1}/_{16}$ inch (1.6 mm) thick preformed neoprene.

iii. Grooved and Shouldered Pipe End Couplings:
(1) Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
(2) Sealing Gasket: C-shape elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
(3) Accessories: Steel bolts, nuts, and washers.

iv. Dielectric Connections:
(1) Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
(2) Use dielectric unions between all dissimilar piping materials.

f. GATE VALVES

i. Over 2-1/2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.
(2) Iron body, bronze trim, bolted bonnet, non-rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

g. GLOBE OR ANGLE VALVES

i. Over 2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.
(2) Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

h. BALL VALVES

i. Up To and Including 2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.
(2) Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged.

i. PLUG VALVES

i. Up To and Including 2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.
(2) Bronze body, bronze tapered plug, 70 percent port opening, non-lubricated, Teflon packing, threaded ends.
(3) Operator: One plug valve wrench for every ten plug valves minimum of one.
ii. Over 2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.
(2) Cast iron body and plug, 70 percent port opening, pressure lubricated, Teflon packing, flanged ends.
(3) Operator: Each plug valve with a wrench with set screw.

j. BUTTERFLY VALVES

i. Manufacturers:
(1) Apollo.
(2) Crane.
(3) Hammond.
ii. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
iii. Disc: Aluminum bronze or stainless steel.
iv. Operator: 10 position lever handle.

k. SWING CHECK VALVES

i. Up To and Including 2 Inches (50 mm):
(1) Manufacturers:
(a) Apollo.

(b) Crane.
(c) Hammond.

(2) Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

ii. Over 2 Inches (50 mm):

(1) Manufacturers:
(a) Apollo.
(b) Crane.
(c) Hammond.

(2) Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

l. SPRING LOADED CHECK VALVES

i. Manufacturers:
(1) Apollo.
(2) Crane.
(3) Hammond.

ii. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

m. EQUIPMENT AND PIPING IDENTIFICATION

i. See Section 15190, Mechanical Identification

n. SLEEVES (PIPING)

i. Sleeves in exterior walls, provide Link-Seal modular wall and casing seal.
ii. Provide sleeves for all piping passing through fire walls.
iii. Size: Annular clear space of approximately ½" for caulked sleeves.
iv. Insulation and covering shall be continuous through sleeve.
v. Sealing through Fire walls: 3M Fire Barrier cover CP25 or Putty 303 approved for 2-hour floor extending full depth through the wall.

3. EXECUTION

a. PREPARATION

i. Ream pipe and tube ends. Remove burrs.
ii. Remove scale and dirt on inside and outside before assembly.
iii. Prepare piping connections to equipment with flanges or unions.
iv. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
v. After completion, fill, clean, and treat systems. Refer to Section 15545

b. INSTALLATION

i. Install in accordance with manufacturer's instructions.
ii. Install heating water, condenser water, and chilled water to ASME B31.9.
iii. Route piping in orderly manner, parallel to building structure, and maintain gradient.
iv. Install piping to conserve building space, and not interfere with use of space.
v. Group piping whenever practical at common elevations.
vi. Sleeve pipe passing through partitions, walls and floors.
vii. Slope piping and arrange to drain at low points.
viii. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 15121.
ix. Inserts:
(1) Provide inserts for placement in concrete form work.
(2) Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
(3) Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
(4) Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
(5) Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

x. Pipe Sleeves
(1) Drill or cut hole for casing seal for tight fit.
(2) Weld or caulk around seal at exterior face.
(3) Caulk seal at interior face.
xi. Pipe Hangers and Supports:
(1) Install in accordance with ASTM B31.9, ASTM F708, and MSS SP89.
(2) Support horizontal piping as scheduled.
(3) Install hangers to provide minimum ½ inch (13 mm) space between finished covering and adjacent work.
(4) Place hangers within 12 inches (300 mm) of each horizontal elbow.
(5) Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
(6) Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
(7) Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
(8) Provide copper plated hangers and supports for copper piping.

(9) Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

xii. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 15260.

xiii. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08305.

xiv. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

xv. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

xvi. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09900.

xvii. Install valves with stems upright or horizontal, not inverted.

END OF SECTION 15510

SECTION 15515

HYDRONIC SPECIALTIES

1. GENERAL

a. SECTION INCLUDES

i. Expansion tanks.
ii. Air vents.
iii. Air separators.
iv. Strainers.
v. Pump suction fittings.
vi. Combination fittings.
vii. Flow indicators, controls, meters.
viii. Relief valves.

b. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, and model number.
iii. Submit inspection certificates for pressure vessels from authority having jurisdiction.
iv. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

c. PROJECT RECORD DOCUMENTS

i. Submit under provisions of Section 01700.
ii. Record actual locations of flow controls, flow meters, and all equipment and materials under this section.

d. OPERATION AND MAINTENANCE DATA

i. Submit under provisions of Section 01700.
ii. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

e. QUALIFICATIONS

i. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

f. DELIVERY, STORAGE, AND HANDLING

i. Deliver, store, protect and handle products to site under provisions of Section 01600.
ii. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
iii. Provide temporary protective coating on cast iron and steel valves.
iv. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
v. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
vi. Furnish extra materials under provisions of Section 01700.

2. PRODUCTS

a. DIAPHRAGM-TYPE EXPANSION TANKS

i. Manufacturers:
(1) Armstrong.
(2) Other acceptable manufacturers offering equivalent products.
(a) Amtrol.
(b) Watts.
(c) or equal.
ii. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible butyl diaphragm sealed into tank, and steel support stand.
iii. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 20 psig.
iv. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

b. AIR VENTS

i. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with _ inch brass needle valve at top of chamber.
ii. Float Type:
(1) Manufacturers:
(a) Armstrong.
(b) Bell & Gossett.
(c) or equal.
(2) Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

c. AIR SEPARATORS

i. Combination Air Separators/Strainers:
   (1) Manufacturers:
      (a) Armstrong Model VAS-2.
      (b) Amtrol.
      (c) or approved equal.
   (2) Steel, tested and stamped in accordance with ASME SEC 8-D; for 125 psig operating pressure, with integral galvanized steel strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

d. STRAINERS

i. Size 2 inch and Under:
   (1) Manufacturers:
      (a) Armstrong.
      (b) Watts.
      (c) or equal.
   (2) Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

ii. Size 2-1/2 inch to 4 inch:
   (1) Manufacturers:
      (a) Armstrong.
      (b) Watts.
      (c) or equal.
   (2) Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

iii. Size 5 inch and Larger:
   (1) Manufacturers:
      (a) Armstrong.
      (b) Watts.
      (c) or equal.
   (2) Flanged iron body for 175 psig working pressure, basket pattern with _ inch stainless steel perforated screen.

e. PUMP SUCTION FITTINGS

i. Manufacturers:
   (1) Armstrong.
   (2) Other acceptable manufacturers offering equivalent products.
      (a) Bell & Gossett.
      (b) Watts.
      (c) or equal.

ii. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings,

disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

iii. Accessories: Adjustable foot support, blow down tapping in bottom, gage tapping in side.

f. COMBINATION PUMP DISCHARGE VALVES

i. Manufacturers:
(1) Armstrong.
(2) Other acceptable manufacturers offering equivalent products.
(a) Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

g. FLOW CONTROLS

i. Manufacturers:
(1) Flow Design Inc.
(2) Other acceptable manufacturers offering equivalent products.
(a) Grinnell.
(b) Armstrong.
(c) or equal.

ii. Construction: Brass or bronze body with union on inlet, and outlet, temperature and pressure test plug on inlet blow-down/back-flush drain.

iii. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psig.

iv. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

v. Accessories: In-line strainer on inlet and ball valve on outlet.

h. RELIEF VALVES

i. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

3. EXECUTION

a. INSTALLATION

i. Install specialties in accordance with manufacturer's instructions.

ii. Where large air quantities can accumulate, provide enlarged air collection stand pipes.

iii. Provide manual air vents at system high points and as indicated.
iv. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
v. Provide air separator on suction side of system circulation pump and connect to expansion tank.
vi. Provide valved drain and hose connection on strainer blow down connection.
vii. Provide pump suction fitting on suction side of in-line centrifugal pumps. Remove temporary strainers after cleaning systems.
viii. Provide combination pump discharge valve on discharge side of in-line centrifugal pumps.
ix. Support pump fittings with floor mounted pipe and flange supports.
x. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
xi. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
xii. Pipe relief valve outlet to nearest floor drain.
xiii. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

b. SCHEDULE - Conform to schedule on plans

END OF SECTION 15515

SECTION 15540

HVAC PUMPS

1. GENERAL

a. SECTION INCLUDES

i. Vertical in-line pumps.

b. PERFORMANCE REQUIREMENTS

i. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

c. SUBMITTALS

i. Submit under provisions of Section 01300.
ii. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
iii. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
iv. Millwright's Certificate: Certify that base mounted pumps have been aligned.

d. OPERATION AND MAINTENANCE DATA

i. Submit under provisions of Section 01700.
ii. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

e. QUALIFICATIONS

i. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five years experience.

f. REGULATORY REQUIREMENTS

i. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

g. EXTRA MATERIALS

i. Furnish under provisions of Section 01700.
ii. Provide one set of mechanical seals for each pump.

2. PRODUCTS

a. MANUFACTURERS

i. Armstrong.
ii. Other acceptable manufacturers offering equivalent products.
(1) Bell & Gossett.
(2) Red Jacket.
(3) Taco
(4) Paco
iii. Substitutions: Under provisions of Section 01600.

b. VERTICAL IN-LINE PUMPS

i. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psig working pressure.
ii. Casing: Cast iron, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
iii. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
iv. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
v. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
vi. Motor: 1750 rpm variable speed unless specified otherwise; refer to Section 15170.
vii. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
viii. VFD Manufacturer to match motor manufacturer to prevent mismatch between drive and motor.

3. EXECUTION

a. PREPARATION

i. Verify that electric power is available and of the correct characteristics.

b. INSTALLATION

i. Install in accordance with manufacturer's instructions.

ii. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

iii. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

iv. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized combination pump discharge valve on pump discharge.

v. Provide air cock and drain connection on horizontal pump casings.

vi. Provide drains for bases and seals, piped to and discharging into floor drains.

vii. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03300. Lubricate pumps before start-up.

c. SCHEDULES

i. See schedule on plans

END OF SECTION 15540

SECTION 15550

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents.

1.3 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Specification sections covering Roof Accessories.

SECTION 235100-2 BREECHINGS, CHIMNEYS, AND STACKS

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Metal Products; MASCO Corporation.
2. Cleaver-Brooks; Div. of Aqua-Chem Inc.
3. FAMCO.
4. Hart & Cooley, Inc.
5. Heat-Fab, Inc.
6. Industrial Chimney Company.
7. LSP Products Group, Inc.
8. Metal-Fab, Inc.
9. Schebler Co. (The).
10. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
11. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
12. Tru-Flex Metal Hose Corp.
13. Van-Packer Company, Inc.

B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

D. Inner Shell: ASTM B 209 Type 1100, 3003 or 3105 aluminum, or ASTM A 666, Type 430 stainless steel.

E. Outer Jacket: Galvanized steel.

F. Accessories: Tees, elbows, increasers, concentric adapter box, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

2.2 GUYING AND BRACING MATERIALS

A. Cable: Galvanized, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch in diameter.
2. For ID Sizes 4 to 15 Inches: 5/16 inch.
3. For ID Sizes 18 to 24 Inches: 3/8 inch.

SECTION 235100-3 BREECHINGS, CHIMNEYS, AND STACKS

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Type B Vents: Vents for certified gas appliances.

3.3 INSTALLATION OF LISTED VENTS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

C. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

D. Lap joints in direction of flow.

E. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

G. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 15550

SECTION 16000

GENERAL ELECTRICAL

1. GENERAL

a. GENERAL REQUIREMENTS

i. CONDITIONS OF THE CONTRACT and DIVISION 1.
ii. If any discrepancies between this Section and Division 1 should arise, contact the Engineer who will resolve such differences in writing.
iii. Conform to General Conditions and Supplemental Conditions.
iv. Conform to Section 01011 and Division 1

b. SECTION INCLUDES

i. Description of Work.
ii. Pre-Bid Coordination.
iii. Definitions.
iv. Drawing Methods.
v. Codes, Permits, and Fees.
vi. Workmanship.
vii. Guarantee.
viii. Submittals.
ix. Revisions.
x. Existing Equipment and Materials.
xi. Materials.
xii. Or Equal Products.
xiii. Demolition.
xiv. Completion Testing and Clean-Up.
xv. Final Inspection, Corrections, and Payment.

c. DESCRIPTION OF WORK

i. Furnish and install all labor, material, equipment, facilities, and transportation required for installation of a complete safe, workable, electrical system as indicated by Contract Drawings and the Electrical Specifications. All Work shall be in complete compliance with all local, State and National applicable codes, and as approved by Engineer. Items not specifically mentioned in the Specifications or noted on the Drawings, but which are necessary for a complete properly functioning installation, shall be included as a part of these Contract Requirements.
ii. Wiring and installation of electrical components shall be off of existing service connections but shall be on separate circuits except as authorized by Construction Manager. Do not damage existing wiring, equipment, or service.

iii. Design and workmanship shall be in conformance with these specifications.

d. PRE-PROPOSAL COORDINATION

i. The Contractor and electrical sub-contractor shall examine all Drawings (including mechanical and architectural) and Specification, et cetera. Any contradictions, discrepancies or design feature which the Contractor does not believe meets codes, or will not properly function as shown or intended, shall be reported in writing (96) hours prior to proposal opening to the Engineer. If no discrepancies, et cetera are reported, it will be assumed that the above conditions have been complied with. The Contractor will be responsible for providing a complete properly operating electrical installation of type shown and specified without any additional cost to Owner.

ii. It shall be the Contractor's responsibility to determine which trade or sub-contractor shall perform such items of Work as excavation/backfilling, cutting, and patching, et cetera and to ensure that all such Work is provided for in the Proposal Sum.

e. DEFINITIONS

i. "Provide" shall mean "furnish and install".
ii. "Indicated" shall mean "indicated on Drawings".
iii. "Noted" shall mean "noted on Drawings or specifications".
iv. Concealed" shall mean "hidden from sight as in trenches, chases, furred spaces, or hung ceilings".
v. "Exposed" shall mean "not concealed", as defined above.
vi. References within Division 16 to "Contractor", also referred to as "the Contractor" or "this Contractor", shall mean "the Electrical Subcontractor".

f. Electrical Contractor shall coordinate all work and equipment requirements with the Mechanical Contractor. See Specification section 15000.3.g for an explanation of separation of responsibilities.

g. DRAWING METHODS

i. The Drawings are diagrammatic. The size and location of equipment are drawn to scale wherever possible but some symbols are distorted dimensionally to obtain clarity in representation.

ii. It is intended that all outlets be located symmetrically with Architectural elements and coordinated with equipment furnished by the Owner or other trades.

iii. The Drawings show the required size, number, and type of wires therein and points of termination of the conduits, but do not show the intended

routing or total number of conduits required for the circuits shown. Additional conduits shall be installed by the Contractor wherever needed to complete the installation of the wiring required for the specific equipment furnished.

iv. Riser and other diagrams are schematic only and do not necessarily show the physical arrangement of the equipment. They shall not be used to obtain quantities or lineal runs of conduit.

v. The plans and specifications are complimentary and everything called for in either is as binding as if called for in both.

h. CODES, PERMITS, AND FEES

i. Conform to Section 01011 and Division 1.

ii. All Work shall comply with the current requirements of all applicable local, state, and national codes and ordinances.

iii. It shall be the responsibility of the Contractor to fully inform himself of all such requirements.

i. WORKMANSHIP

i. All Work shall be performed by skilled, qualified workmen, with adequate experience in their trade to execute all Work intended.

ii. All Work shall be done in accordance with manufacturer's instructions and recommendations, except where the Drawings or these Specifications specifically indicate other instructions.

j. GUARANTEE

i. Per Section 01700.

k. SUBMITTALS

i. Contractor shall submit Shop Drawings and manufacturer's data on equipment to be used to Engineer for approval in accordance with requirements on Section 01300.

ii. All electrical submittals shall be submitted at one time, not piecemeal.

iii. Contractor shall submit data for <u>all</u> materials and equipment he proposes to use and furnish.

iv. The submittal data shall be as follows:

(1) Catalog Cuts: To be furnished for all standard (off-the-shelf) catalog items. Catalog cuts shall show the manufacturer, catalog number, and complete specifications including rating, finish, dimensions, kind of materials used, et cetera.

(2) Shop Drawings: To be furnished for all nonstandard or uncataloged items. Shop Drawings shall show manufacturer, manufacturer's type designation and complete specifications,

including rating, finish, dimensions, kind of materials, et cetera.

v. All submittals shall be coded or keyed to match the Drawing or Specification designation.

vi. Provide accurate "as built" record documents, per requirements of Section 01700.

vii. O & M Manuals: Conform to the requirements of Section 01730.

viii. Warranties: Conform to the requirements of Section 01700.

l. REVISIONS

i. There shall be no changes regarding the intent of these Drawings or Specifications or materials previously approved without the written approval of the Engineer. Any changes believed to be necessary by the Contractor shall be brought to the attention of the Engineer for his approval.

m. EXISTING EQUIPMENT AND MATERIALS

i. Contractor shall determine existing equipment and materials as required to perform work indicated on Drawings.

2. PRODUCTS

a. MATERIALS

i. All materials and equipment used on this project shall be new, in an unused condition when delivered to the site, and are required to bear the U.L. label.

b. OR EQUAL PRODUCTS

i. Items of equipment or materials referred to in these Specifications and on the Drawings are used for the purpose of establishing a quality and standard of materials. Equal materials by manufacturer's other than those named in the Specification may be used only if submitted and approved as equal products in accordance with requirements of Section 01300. Those products which state "OR APPROVED EQUAL" must be submitted for approval before notice to proceed is issued.

ii. The Contractor shall be responsible for checking equipment dimensions of proposed substitute equipment and be responsible for its fitting the spaces allowed.

iii. The cost of any redesigning caused by a substitution shall be borne by the Contractor.

3. EXECUTION

a. DEMOLITION

i. The Contractor shall remove all fixtures, switches, receptacles, conduit, wiring, and miscellaneous equipment as indicated on Drawings or as required by job conditions.
ii. All demolition Work shall be closely coordinated with the other trades and requirements of this specification.
iii. Materials removed during the demolition phase of the Work shall become the property of the Contractor, and shall be removed from the site, unless specifically noted otherwise in the Specifications, the Drawings, or the USPS Clauses, Division 01. This shall include materials such as conduit, outlets, and wiring which was not in use prior to this contract.
iv. All existing equipment which is to be relocated shall be removed and reinstalled at a time convenient to the Owner. Permission for removal must be obtained from a designated representative of the Owner before any Work is started and equipment must be reinstalled in the new location in as short a time as possible, utilizing normal working hours.
v. All existing fixtures and equipment associated with this contract shall be completely cleaned, renovated, relamped, tested, and adjusted as directed by the Engineer.
vi. Make fixture or equipment mounting modifications if required or directed.
vii. All existing equipment left remaining shall be maintained in service. When encountered in Work, whether shown on the Drawings or not, protect, brace, and support existing active sewers, gas, electric, or other services where required for proper execution of the Work. If existing active electrical services are encountered that require relocation in order to execute general, electrical, or mechanical Work, relocate services as required and/or directed without additional cost to the Owner. Any equipment which is not specifically indicated for removal or is not shown or noted shall remain in service.

b. COMPLETION, TESTING AND CLEAN UP

i. Upon completion of all electrical Work, the Contractor shall thoroughly clean all equipment and premises of any tools, crates, boxes, wire, et cetera related to the electrical Work. Contractor shall perform all tests required by the Engineer or to comply with local, state, or federal regulations. Tests shall assure a complete, balanced, and safely operating system, including, but not limited to, all tests required by other Sections of this Specification.

c. FINAL INSPECTION(S), CORRECTIONS AND PAYMENT

i. During pre-final and final inspection, the electrical sub-contractor shall have a representative present for removal and replacement of any ceiling tile, box face plates, panel fronts, et cetera requested by the Engineer for

inspection purposes. A written list of unacceptable conditions, required changes, et cetera, will follow inspection and the Contractor shall immediately make changes, corrections, et cetera, required. Final contract payment will not be made until this has been completed to Engineer's and Owner's satisfaction. Refer also to applicable sections of Section 01300.

END OF SECTION 16000

SECTION 16060

MINOR ELECTRICAL DEMOLITION FOR REMODELING

1. GENERAL

   a. GENERAL REQUIREMENTS

      i. Conform to General Conditions and Supplemental Conditions.
      ii. Conform to Section 01011 and Division 1

   b. SECTION INCLUDES

      i. Materials and Equipment.
      ii. Examination.
      iii. Preparation.
      iv. Demolition and Extension of Existing Electrical Work.
      v. Cleaning and Repair.

   c. RELATED SECTIONS

      i. Section 02072 - Minor Demolition for Remodeling.

2. PRODUCTS

   a. MATERIALS AND EQUIPMENT

      i. Materials and equipment for patching and extending work: As specified in individual Sections.

3. EXECUTION

   a. EXAMINATION

      i. Verify field measurements are as shown on Drawings.
      ii. Verify circuiting arrangements are as shown on Drawings or are as indicated by panel directories and equipment labeling at job site.
      iii. Verify that abandoned wiring and equipment serve only abandoned facilities.
      iv. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer before disturbing existing installation.
      v. Beginning of demolition means installer accepts existing conditions.

b. PREPARATION

i. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

ii. Coordinate utility service outages with the Owner.

iii. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

iv. Generator Relocation: Maintain existing generator in service to maximum extent possible. Maximum length of time allowed for generator power not being available to the Owner is 48 hours (one continuous period). Generator outage shall only occur on a weekend. Schedule the outage at the Owner's convenience, not the contractor's.

v. All Systems: Disable system only to make switch overs and connections. Notify the Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

vi. Temporary Lighting: Where removal of existing lighting is required, provided temporary lighting systems (contractor designed) in affected areas until new lighting systems are installed and energized.

c. DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

i. Demolish and extend existing electrical work under Section 02072 and provisions of this Section.

ii. Remove, relocate, and extend existing installations to accommodate new construction.

iii. Repair adjacent construction and finishes damaged during demolition and extension work.

iv. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

v. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

vi. Relocate existing electrical conduits/raceways/hangers as required to accommodate new work shown on the mechanical, structural, and architectural drawings.

d. CLEANING AND REPAIR

i. Clean and repair existing materials and equipment which remain or are to be used.

ii. Panel boards: Clean exposed surfaces and check tightness of electrical connections. Report damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION 16060

SECTION 16110

RACEWAYS & CONDUIT

1. GENERAL

a. GENERAL REQUIREMENTS

i. Conform to General Conditions and Supplemental Conditions.
ii. Conform to Section 01011 and Division 1
iii. Provide complete raceway and conduit system.
iv. All wires and cables shall be concealed unless noted otherwise.
v. Separate raceway/conduit systems shall be provided for each of the various wiring systems (power, television, telephone, et cetera).
vi. Supply and install per manufacturer's instructions. .
vii. Where existing raceways are present, they may be reused if size and routing is compatible with new requirements.

b. REFERENCES

i. ANSI/NFMA FB 1 - Nation Electrical Code.
ii. NECA "Standard of Installation".

c. CODES AND STANDARDS

i. Raceways and conduits shall be sized in conformance to ANSI/NFPA 70.
ii. If any conflict occurs between legally adopted codes and this Specification, the codes are to prevail, except that this shall not be construed as relieving the Contractor from complying with any requirements of the plans or specifications which may be in excess of code requirements and not contrary to same. Notify Engineer of conflicts in the documents with regulations prior to commencing Work.
iii. All materials and equipment installed, including lighting fixtures, shall have been tested and listed by Underwriters' Laboratories (or other code recognized laboratory) unless otherwise permitted by the Code Inspector and the Owner.
iv. NFPA No. 70 National Electric Code (as adopted and amended by the State of Alaska).
v. Utility Company Regulations.
vi. The Contractor is required to familiarize himself with the detailed requirements of these standards and any local codes and ordinances as they affect the installation of specific electrical systems.

d. SUBMITTALS

i. Conform to Section 01300.

ii. Product Data: Provide for metallic conduit, flexible metal conduit, liquid tight flexible metal conduit, metallic tubing, fittings, conduit bodies.
iii. Submit “As Built Drawings” under provisions of Section 01700.
iv. Accurately record actual routing of conduits larger than 1".

e. DELIVERY, STORAGE, AND HANDLING

i. Deliver, store, protect, and handle products to site under provisions of Section 01600.
ii. Accept on site. Inspect for damage.
iii. Protect from corrosion and entrance of debris and water by storing above grade.
iv. Provide appropriate covering.

f. PROJECT CONDITIONS

i. Verify that field measurements are as shown on Drawings.
ii. Verify routing and termination locations of conduit prior to rough-in.
iii. Routing is shown on Drawings in approximate locations unless dimensioned.
iv. Route as required to complete wiring system.

g. PROHIBITED MATERIALS

i. Indentation or set screw type terminations or couplings.
ii. Aluminum wire or conduit.

h. EXECUTION

i. Prohibited Locations:
(1) Electrical metallic tubing shall not be installed underground or in concrete.
ii. Required Locations:
(1) Rigid steel conduit shall be utilized for all above-grade exterior runs, for all feeders, for all raceways larger than 1½” , for all conduits installed underground, and for all runs in concrete or masonry.
(2) Flexible conduit shall be used only for connections to recessed lighting fixtures, motors and equipment, and shall be limited to dry locations. Keep flexible conduit as short as practical. Generally, flexible conduit should be 2' or less in length.
(3) Liquid tight flexible conduit shall be used in place of flexible conduit in damp or wet locations. This shall include all connections to pumps.
(4) Surface metal raceways shall be used only in finished areas where surface raceways are required by building conditions, and where

specifically noted on the drawings.

i. INSTALLATION

i. In general, all new raceways shall be concealed unless specifically noted otherwise. Installation shall conform to the best trade practices in all respects. Make runs parallel or at right angles to structural framing, properly supported, and protected.

2. PRODUCTS

a. RIGID GALVANIZED STEEL CONDUIT (RGS)

i. Manufacturers: Allied, National, Columbia.
ii. Rigid steel Conduit: ANSI C80.1 Hot dipped galvanized with galvanized malleable iron or noncorrosive alloy threaded fittings compatible with galvanized conduit. Running thread or set screw fittings not permitted. (Exception: Erickson couplings, OZ or equivalent watertight split couplings permitted).
iii. Fittings and Bodies:
(1) ANSI/NEMA FB1.
(2) Fittings:
(a) Galvanized malleable iron or non- corrosive alloy compatible with galvanized conduit.
(b) Running thread or set screw fittings not permitted
(c) Exception: Erickson couplings, watertight split couplings (OZ type or equivalent permitted.

b. ELECTRICAL METALLIC TUBING (EMT)

i. Manufacturers: Allied Tube and Conduit, Triangle, Western Tube and Conduit, Wheatland.
ii. Description: ANSI C80.3; hot dipped galvanized, electro galvanized, or shearadized steel tubing.
iii. Fittings and Bodies:
(1) ANSI/EMA FB 1.
(2) Rain tight; steel type using a split corrugated compression ring and tightening nut or stainless steel locking disc.
(3) Set screw, indenter or die-cast fittings are not acceptable.

c. FLEXIBLE METAL CONDUIT

i. Manufacturers: National Electric, OZ Gedney "Flexi-guard", American Brass Co. "Sealtite", Columbia "Flex-Seal".
ii. Description: Interlocked steel construction with PVC jacket.
iii. Fittings: ANSI/NEMA FB 1. T&B "Super-Tite" or equal.

d. FLEXIBLE CONDUIT

i. Manufacturers: National, Allied, Columbia, OZ, American Brass.
ii. Description: Interlocked steel construction.
iii. Fittings: ANSI/NEMA FB 1.
iv. Galvanized flexible steel for dry locations.
v. Fittings:
(1) Malleable iron or steel, Thomas and Betts "Super-Tite" or equal.
(2) Use fittings approved for raceway ground continuity where a separate ground wire is not contained within the raceway.
vi. Liquid Tight:
(1) Use liquid tight for pumps, for equipment which is regularly washed down, and for equipment in damp locations.
(2) PVC weatherproof cover over flexible steel conduit for damp and wet locations.
(3) Fittings: Thomas and Betts "Super-Tite" or equal.
vii. Flexible metallic tubing may not be used.
viii. Provide bonding jumper when required by code.

e. PVC CONDUIT

i. Not Allowed.

3. INSTALLATION

a. GENERAL

i. Install Rigid Galvanized Steel Conduit (RGS) concealed in construction unless noted otherwise in the following, on the drawings, or unless specifically approved by the Engineer.
ii. Intermediate metal conduit is permitted as a substitute for rigid galvanized steel except where RGS is required by code and as allowed below or specifically shown on the plans.
iii. Interior: Route raceways parallel with building lines. (Exception: Raceways below grade or imbedded in concrete.)
iv. Grounding: Raceway system serves as equipment ground; make all joints tight for minimum impedance.

b. APPLICATION

i. Dry locations: Rigid steel conduit, intermediate metal conduit, or electrical metallic tubing as permitted.
ii. Wet Locations: Rigid steel and intermediate metal conduit.
iii. Use: Do not intermix types of conduit on any single or parallel conduit run.

iv. Electrical Metallic Tubing:
(1) May be substituted for RGS for circuits concealed in construction and for wiring in furred ceilings and above suspended ceilings.
(2) May be used for exposed Work in unfinished areas above 10' finished floor elevation.
(3) Grounding: Where raceway system serves as equipment ground; make all joints tight for minimum impedance.
(4) Not permitted for sizes greater than 2" nominal diameter.
(5) Not permitted unless specifically noted on drawings.

v. Flexible Raceways:
(1) Permitted for final connection to devices and equipment above suspended ceilings.
(2) Permitted for branch circuit wiring only where specifically authorized by Owner on a case-by-case basis.
(3) Required for final raceway connection to motors and equipment with minimum 90 degree loop to allow for vibration isolation.

vi. Rigid Galvanized Steel Conduit (RGS): All connections shall be watertight.

vii. Rigid Aluminum Conduit: Not used.

viii. Raceways That Penetrate Building Exterior: Not Allowed.

c. INSTALLATION

i. Reference:
(1) Install conduit in accordance with NECA "Standard of Installation".

ii. Minimum Sizes:
(1) Branch Circuits: ¾" unless otherwise specified.
(2) Home Runs (over 7 conductors): 1" minimum. Size as required for conductor size and number.

iii. Bends: Carefully made, to avoid injuring or flattening. Bends 1-¼" and larger shall be factory elbows or formed utilizing an approved bending process.

iv. Securing Raceways: Fasten to frame structures by means of clamps, screws, metal inserts, or toggle bolts. Nails not permitted.

v. Preparation of Raceways: Swab out all raceway before wires are pulled. Clean, remove any debris, and insure that raceway is dry.

vi. Hangers for Raceways:
(1) In suspended ceiling spaces Contractor may not attach raceways to the ceiling suspension system.
(2) When more than 2 conduits will use the same routing, group together on a patented channel support system (such as Unistrut).

vii. Supports:
(1) Arrange supports to prevent misalignment during wiring

installation.

(2) Supports shall be spaced every 10'.

(3) Group related conduits and when more than two use the same routing; support using conduit trapeze rack and minimum _" threaded rod. Construct rack using "Unistrut" type steel channel; provide space on each for 25% additional conduits.

(4) Fasten conduit supports to building structure and surfaces.

(5) Supports for 1" conduit and less may be #9 wire pendant. Do not support other conduit sizes with wire or perforated pipe straps. Remove wire used for temporary supports.

(6) Supports for 2" and smaller may be one hole clamps.

(7) Supports for conduit over 2" shall be steel channel rack with a minimum of 2 anchors to the building structure per hanger.

(8) Pipe clamps for use with a channel support rack may be one piece (2 bolts into the channel) or 2 piece (single bolt clamping the 2 pieces).

(9) Do not attach conduit to ceiling support wires.

(10) Provide lateral support for suspended raceway every 20 feet and longitudinal support every 40 feet.

viii. Arrangement:

(1) Arrange conduit to maintain headroom and present neat appearance.

(2) Install concealed in construction unless noted otherwise on the Drawings.

(3) Route conduit parallel and perpendicular to walls.

(4) Maintain adequate clearance between conduit and piping.

(5) Maintain 12" clearance between conduit and surfaces with temperatures exceeding 104^0 F.

(6) Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2" size.

(7) Install conduit at least 8" above fixtures in lay-in ceilings to accommodate fixture relocation.

ix. Routing:

(1) Home runs shall extend from ceiling outlets or junction boxes, not wall outlets to facilitate future wall removal. Add additional junction boxes as required.

(2) Maintain existing headroom. Do not block access to junction boxes, valves, mechanical equipment, et cetera.

(3) Verify structural design for installation constraints when fastening or penetrating structural members.

(4) Provide pullboxes as required to avoid excess conductor pulling tension and/or to comply with 270 degree bend code requirement.

(5) Do not route conduit closer than 6 inches from parallel run of heating systems or hot water piping.

x. Installation:
   (1) Cut conduit square using saw or pipe cutter; de-burr cut ends.
   (2) Bring conduit to shoulder of fittings; fasten securely.
   (3) Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
   (4) Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
   (5) Use suitable caps to protect installed conduit against entrance of dirt and moisture.
   (6) Ground and bond conduit.
   (7) Cap raceway during construction with manufactured seals to prevent entrance of water or debris.
   (8) Slope raceway to prevent trapping of seepage or condensation.

d. INTERFACE WITH OTHER PRODUCTS

   i. Install conduit to preserve fire resistance rating of partitions and other elements.

END OF SECTION 16110

SECTION 16120

WIRE AND CABLE

1. GENERAL

   a. SECTION INCLUDES

      i. Description of Work.
      ii. Related Requirements.
      iii. Submittals.
      iv. Materials.
      v. Acceptable Manufacturers.
      vi. Installation.

   b. DESCRIPTION OF WORK

      i. A complete system of wires shall be installed in the raceway system. Unless otherwise noted, all wiring shall be copper.

   c. SUBMITTALS

      i. Manufacturer's name, model or type number, per Section 01300.

2. PRODUCTS

   a. MATERIALS

      i. All wiring shall be copper unless specifically noted otherwise, and shall be rated at 600 volts.
      ii. Wire sizes 12 and 10 shall be solid, Type THHN. Wire sizes 8 and larger shall be stranded, Type THW, THWN, or THHN. Minimum wire size shall be 12 AWG, unless noted.
      iii. All wire shall be marked with gauge and insulation type on 24" centers, and color coded as required by the N.E.C.
      iv. All wire and cable shall be brought to the job in the original containers bearing the U.L. label.
      v. Molded connectors with metal thread-on core shall be used for splicing 12 and 10 wire. Stranded cables shall be connected to lugs using mechanical connectors, and shall be wrapped with electrical tape to a thickness equal to the wire insulation.

   b. ACCEPTABLE MANUFACTURERS

      i. Wire and cable shall be as manufactured by Rome, General Cable, Southwire, Anaconda-Ericson, Okonite, General Electric, or Excell.

ii. Molded connectors shall be as manufactured by 3M or Buchanan.
iii. Mechanical connectors shall be manufactured by Burndy, O.Z./Gedney Co., or Thomas & Betts.
iv. Tape shall be manufactured by 3M.
v. Wire pulling lubricant shall be powdered soapstone, powdered mica, or "Y-ER-EAS".
vi. Substitutions may be considered only when submitted in conformance with Division.

3. EXECUTION

a. INSTALLATION

i. Wires shall be pulled in such a manner as to avoid kinking or abrasion to the insulation. Use only approved lubricants. Oil or grease shall not be used to lubricate wires.
ii. Make sure that all couplings and conduit connectors have pre-insulated busings in place before pulling wires.
iii. Where more than 3 current carrying conductors are installed in a single raceway, the minimum wire size shall be increased to comply with NEC 310-16, Note 8. Where the distance from the over current device to the first outlet exceeds 100 feet, the minimum wire size shall be #10 AWG. Minimum Wire size for HID light circuits shall be #10 AWG.
iv. Wiring may be combined in home runs as long as circuit numbers are maintained as shown, and if revisions are identified on the "As-Built" Drawings.
v. Provide separate ground bonding conductor full length of all flexible conduit (and liquid tight flexible conduit) inside conduit in addition to integral bonding tape, in all PVC raceways, and for all exterior devices and fixtures.
vi. Conductor length for parallel feeders shall be identical.
vii. Except where conductor sizes are indicated on the Drawings, the following schedule shall be adhered to:

CIRCUIT OVER CURRENT	
DEVICE RATING	WIRE SIZE
20 amperes or less	12
30 amperes	10
40 amperes	8
50 amperes	6
60, 70, and 80 amperes	4
90 and 100 amperes	2

END OF SECTION 16120

SECTION 16130

OUTLETS, JUNCTION, AND PULLBOXES

1. GENERAL

a. GENERAL REQUIREMENTS

i. Conform to General Conditions and Supplemental Conditions.
ii. Conform to Section 01011 and Division 1

b. SECTION INCLUDES

i. Project Record Documents.
ii. Regulatory Requirements.
iii. Project Conditions.
iv. Outlet Boxes.
v. Pull and Junction Boxes.
vi. Installation.
vii. Blank Covers.
viii. Interface With Other Products.
ix. Adjusting.

c. PROJECT RECORD DOCUMENTS

i. Submit under provisions of Section 01700.
ii. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

d. REGULATORY REQUIREMENTS

i. Conform to requirements of ANSI/NFPA 70.
ii. Furnish products listed and classified by Underwriters Laboratories, Inc.

e. PROJECT CONDITIONS

i. Verify field measurements are as shown on Drawings.
ii. Verify locations of outlets prior to rough-in.
iii. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

2. PRODUCTS

a. OUTLET BOXES

i. Sheet metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel or baked enamel, with return flange and screw retained cover. Device outlets shall be a minimum of 2-¼" deep. Minimum 4" square.
(1) Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include ½" male fixture studs where required.

ii. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer.

b. PULL AND JUNCTION BOXES

i. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
ii. Surface-Mounted Cast Metal Box: NEMA 2509, Type 4; flat-flanged, surface-mounted junction box.
(1) Material: Galvanized cast iron.
(2) Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

3. EXECUTION

a. INSTALLATION

i. General: Coordinate the Work of this Section with the Work of other Sections and trades. Study all Drawings that form a part of this contract and confer with the various trades involved to eliminate conflicts between the Work of this Section and the Work of other trades. Check and verify outlet locations indicated on Architectural Drawings, door swings, installation details, and layouts of ceilings and locations of all plumbing, heating, and ventilation equipment.
ii. Vertical and Horizontal Relationships: Where more than 1 outlet is shown or specified to be at the same elevation or one above the other, align them exactly on center lines horizontally or vertically. Where mis-installed, reinstall at no cost to the Owner.
iii. Device Outlet Height: Mount outlets at heights shown on the architectural details.
iv. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
v. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
vi. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
vii. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.

viii. Install boxes to preserve fire resistance rating of partitions and other elements.
ix. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
x. Finished areas: Use flush mounting outlet boxes with front edge (box or plaster ring) even with the finished surface of the wall or ceiling.
xi. Do not install flush mounting boxes back-to-back in walls; provide minimum 6" separation. Provide minimum 24" separation in acoustic rated walls.
xii. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
xiii. Use stamped steel bridges to fasten flush mounting outlet box between studs.
xiv. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
xv. Use adjustable steel channel fasteners for hung ceiling outlet box.
xvi. Do not fasten boxes to ceiling support wires.
xvii. Support boxes independently of conduit.
xviii. Use gang box where more than one device is mounted together. Do not use sectional box.
xix. Use gang box with plastic ring for single device outlets.
xx. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12" in any dimension.
(1) Interior Dry Locations: Use hinged enclosure.
(2) Other Locations: Use surface-mounted cast metal box.
xxi. Install knockout closures in unused box openings.

b. BLANK COVERS

i. Provide blank covers or plates over all boxes that do not contain devices or are not covered by equipment.

c. INTERFACE WITH OTHER PRODUCTS

i. Coordinate installation of outlet box for special equipment with Owner.
ii. Coordinate locations and sizes of required access doors.
iii. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
iv. Coordinate mounting heights and locations of outlets mounted above counters, benches and backslashes.
v. Position outlet boxes to locate luminaries as shown on reflected ceiling plan.

END OF SECTION 16130

SECTION 16170

GROUNDING AND BONDING

1. GENERAL

   a. SUMMARY

      i. Ground electrical systems completely and effectively, as required by code and as may be more rigidly specified herein.

   b. GENERAL REQUIREMENTS

      i. The provisions of Section 16000, "General Electrical," Section 16010, "Basic Electrical Requirements," and Section 16120 "Wire and Cable" apply to this section as if fully repeated herein.

   c. SUBMITTALS

      i. The following information shall be submitted:
         (1) Catalogue Cuts:
            (a) Ground Connectors.
         (2) Tests and Reports:
            (a) Contractor will perform tests in the presence of a designated USPS representative and report results of tests to the Contracting Office (CO) or designee who will approve or disapprove Contractor's work.
            (b) Contractor shall provide CO with 5 copies of test report.

   d. QUALITY ASSURANCE

      i. Testing
         (1) Contractor shall notify USPS 72 hours in advance of performance of Work requiring testing. Contractor shall provide all necessary material and equipment required for testing.

   e. WARRANTY

      i. Warranty shall comply with the provisions of Section 16000, "General Electrical".

2. PRODUCTS

a. MATERIALS

i. Bolted Connections:
(1) Everdur hardware, bolts, and lock washers.
ii. Compression Connections:
(1) Thomas & Betts Series 5300 fittings. Use manufacturer's specific instructions and tools for each connection.

3. EXECUTION

a. INSTALLATION

i. Grounding System:
(1) Provide ground systems and make connections mechanically secure and electrically continuous.
(a) Provide separate green equipment grounding conductor in electrical raceway to effectively ground panels, controls, motors, disconnect switches, and noncurrent carrying metallic enclosures. Use of metallic raceway as the "equipment grounding conductor" is not acceptable for this project. Use bonding jumpers, grounding bushings, lugs, buses, et cetera for this purpose. Make mechanical and electrical contact at all panel boards, outlet boxes, junction boxes, and wherever the conduit run is connected. Permanently and effectively ground all conduit and other equipment as required by applicable codes, regulations, and standards. The grounding electrode system shall be as required by NEC Section 250-81or 250-83, unless indicated otherwise elsewhere or herein. Connect equipment ground to building system ground. Use same size equipment grounding conductors as phase conductors, up through No. 10 AWG. Use NEC Table 250-95 for conductor size with phase conductors No. 8 and larger, if not indicated elsewhere or on Drawings (if provided).
(b) All conduit stub-ups shall be grounded and where multiple stub-ups are made within an equipment enclosure, such as a switchboard, they shall be equipped with grounding bushings that are to be bonded together to the enclosure and to an enclosure equipment grounding bus.
(c) Motors: Connect grounding conductor to the metal frame with bolted solderless lug. Bolts, screws, and washers: Bronze or cadmium plated steel.
(d) Ductwork: Ensure that a flexible grounding strap is provided, No. 6 AWG equivalent, at each flexible duct connection, at each air handler, exhaust fan, supply fan, and install to preclude vibration.

(e) Install a code sized grounding wire in all installed conduits, unless a larger size is indicated.
(f) System neutrals shall be grounded at the sources of power only.
(g) Provide a separate green color insulated grounding wire in all flexible conduit runs.
(h) Provide green color insulated equipment ground wire for computer equipment.

ii. Grounding Receptacle:
(1) The green insulated grounding (bond) wire shall be connected to metallic outlet box body by means of a threaded ground bushing with set screws and a bonding jumper.
(2) A bonding jumper shall be provided between the set screw connection and the receptacle grounding screw.

iii. Isolated Ground Receptacle:
(1) The green insulated grounding (bond) wire shall be connected to metallic outlet box body by means of a threaded ground bushing with act screws and a bonding jumper.
(2) The green (with yellow striping) insulated, isolated grounding wire shall connect directly to the receptacle isolated ground screw.

iv. Resistance to ground for the facility electrical system should not exceed 3 ohms.

v. The resistance to ground for all systems shall be measured by the "direct" method or "fall-of-potential" method.

vi. The earth electrode under test must be far enough away from the water pipe system to be outside its sphere of influence. Rule of thumb - distance from the earth-electrode system to the water pipe system should be about 10 times the radius of the electrode or grid to obtain a measurement within an accuracy of ± 10%.

b. TESTS

i. The resistance to ground for all systems shall be measured by the "direct" method or "fall-of-potential" method. However, the resistance of the grounding electrode system should be checked only at the time of facility construction or if made accessible because of a major renovation/ remodeling project.

END OF SECTION 16170

SECTION 16190

SUPPORTING DEVICES

1. GENERAL

   a. SECTION INCLUDES

      i. Conduit and equipment supports.
      ii. Anchors and fasteners.

   b. SUBMITTALS

      i. Submit under provisions of Section 01300.
      ii. Product Data: Provide manufacturer's catalog data for fastening systems.
      iii. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

   c. REGULATORY REQUIREMENTS

      i. Conform to requirements of ANSI/NFPA 70.
      ii. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

2. PRODUCTS

   a. PRODUCT REQUIREMENTS

      i. Materials and Finishes: Provide adequate corrosion resistance.
      ii. Provide material, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit when selecting products.
      iii. Anchors and Fasteners:
         (1) Concrete Structural Elements: Use expansion anchors.
         (2) Steel Structural Elements: Use beam clamps, spring steel clips, and welded fasteners.
         (3) Concrete Surfaces: Use expansion anchors.
         (4) Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
         (5) Solid Masonry Walls: Use expansion anchors or preset inserts.
         (6) Sheet Metal: Use sheet metal screws.
         (7) Wood Elements: Use wood screws.

3. EXECUTION

a. INSTALLATION

i. Install products in accordance with manufacturer's instructions.
ii. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
iii. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
iv. Do not use spring steel clips and clamps.
v. Do not use powder-actuated anchors.
vi. Obtain permission from Engineer before drilling or cutting structural members.
vii. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
viii. Install surface mounted cabinets and panel boards with minimum of 4 anchors.
ix. In wet and damp locations use steel channel supports to stand cabinets and panel boards one" off wall.
x. Use sheet metal channel to bridge studs above and below cabinets and panel boards recessed in hollow partitions.

END OF SECTION 16190

SECTION 16195

ELECTRICAL IDENTIFICATION

1. GENERAL

   a. SECTION INCLUDES

      i. Nameplates and labels.
      ii. Wire and cable markers.
      iii. Raceway markers.

   b. REFERENCES

      i. ANSI/NFPA 70 - National Electrical Code.

      ii. REGULATORY REQUIREMENTS
         (1) Conform to requirements of ANSI/NFPA 70.
         (2) Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

2. PRODUCTS

   a. NAMEPLATES

      i. Material: Engraved 1/16" thick, three-layer laminated plastic.
      ii. Nameplate and letter sizes:
         (1) Use 1" wide labels, leave 1-1/2" to right of last engraved character for future bar coding.
         (2) Use 1/2 inch (12 mm) letters for equipment ID number.
         (3) Use 1/8 inch (3 mm) letters for identifying source and location of source for individual equipment and loads.
      iii. Colors:
         (1) Normal Power: Black letters on a white background.
      iv. Locations:
         (1) Each electrical distribution and control equipment enclosure.
         (2) Each remote line isolation monitor.

   b. WIRE MARKERS

      i. Description: Cloth tape, split sleeve, or tubing type wire markers.
      ii. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

iii. Legend:
(1) Power circuits: Branch circuit or feeder number indicated on drawings.

c. RACEWAY MARKERS

i. Description:
(1) Conduits with wiring installed: Use a black indelible marker and hand print label clearly, or use stencil and black paint.
(2) Conduits left empty: Cardboard or plastic handwritten tags.
ii. Location: Equipment end of raceway exiting rooms (or spaces) with the other end of raceway not obvious from space.
iii. Legend:
(1) Raceway to load: Marking should be "L" plus source circuit breaker number (use lower number pole for multi-pole circuits).
(2) Raceway from source: Marking should be "S" plus the source equipment number.
(3) Empty conduits: Description of purpose (power, FA, communications, etc.) and location of opposite end (each end) for future or abandoned conduits.

3. EXECUTION

a. PREPARATION

i. Degrease and clean surfaces to receive nameplates and labels.

b. APPLICATION

i. Install nameplates and label parallel to equipment lines.
ii. Secure nameplate to equipment front using screws or rivets.
iii. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

END OF SECTION 16195

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 LEED CERTIFICATION

A. This project is registered for LEED Certification. See Section 01 81 13 for requirements that may affect the work of this section.

SECTION 262816-2 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Lugs: Mechanical type, suitable for number, size, and conductor material.
2. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
5.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1**,** UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight green ON pilot light.
3. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

SECTION 262816-1 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 16410

SECTION 16511

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.

4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

D. Field quality-control reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

F. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

1.8 LEED CERTIFICATION

A. This project is registered for LEED Certification. See Section 01 81 13 for requirements that may affect the work of this section.

SECTION 265100-2 INTERIOR LIGHTING

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch-minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USE ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
    e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    f. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.
11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts for T5, T8,T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

E. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

F. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.

3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.4 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Nightlight Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.5 BALLASTS FOR HID LAMPS

A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F.
3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 20 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
10. Protection: Class P thermal cutout.

B. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
2. Minimum Starting Temperature: Minus 40 deg F.

2.6 QUARTZ LAMP LIGHTING CONTROLLER

A. General Requirements for Controllers: Factory installed by lighting fixture manufacturer. Comply with UL 1598.

B. Standby (Quartz Restrike): Automatically switches quartz lamp on when a HID lamp in the fixture is initially energized and during the HID lamp restrike period after brief power outages.

C. Connections: Designed for a single branch -circuit connection.

D. Switching Off: Automatically switches quartz lamp off when HID lamp strikes.

E. Switching Off: Automatically switches quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.7 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.8 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.9 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours unless otherwise indicated.

D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

E. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.10 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65 and color temperature 4000 K.

C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

E. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800 K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

SECTION 265100-3 INTERIOR LIGHTING

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16511

SECTION 16521

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
    a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Field quality-control reports.

C. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

D. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

1.7 LEED CERTIFICATION

A. This project is registered for LEED Certification. See Section 01 81 13 for requirements that may affect the work of this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As selected by Architect from manufacturer's full range.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

    a. "USES ONLY" and include specific lamp type.
    b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
    d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
    e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
    f. CCT and CRI for all luminaires.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: Class A
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F and higher.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.

C. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

    a. Restrike Range: 105- to 130-V ac.
    b. Maximum Voltage: 250-V peak or 150-V ac rms.

2. Minimum Starting Temperature: Minus 40 deg F.

2.5 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), CCT color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Low-Pressure Sodium Lamps: ANSI C78.43.

C. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

D. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

E. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80**,** and CCT color temperature 4000 K.

SECTION 265600-3 EXTERIOR LIGHTING

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

END OF SECTION 16521

Port Graham Biomass Project

Prepared for: Chugachmiut

Port Graham Village Council

By: Chena Power

Winters & Associates

CHENA POWER Bringing power to the people

Port Graham Biomass Project

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Port Graham Biomass Project

1 EXECUTIVE SUMMARY

Port Graham Village Council (Port Graham) and Chugachmiut, a non-profit tribal organization serving the Native peoples of the Chugach region, completed preconstruction activities that pave the way towards reduced local energy costs through the construction and operations of a cord wood biomass heating system. When operational, the biomass system will provide heat to four community buildings, reducing diesel consumption by approximately 85% or 5365 gallons annually. The existing diesel-fired hot-water heating system will be retained and used for backup. Community buildings that will be supplied with hot-water heat from the biomass system include the following structures:

- Anesia Anahonak Moonin Health and Dental Clinic
- Port Graham Village Council offices
- Port Graham Public Safety Building/Fire Department
- Port Graham Corporation Office Building which also houses the Port Graham Museum and Head Start Center

In preparation for funding and construction of the cordwood biomass system, the community, through two different funding sources, has completed a construction cost estimate, final design, a harvest and operations plan and has secured all required permits. This report incorporates all necessary documents for Port Graham to proceed with construction of a cordwood biomass system. The proposed cord wood biomass system displaces 80-85% of the heat required to heat the facilities. The project will reduce the funding required for space heating of community facilities and shift a portion of the cost of energy from out of town corporations to local residents – allowing for cash to stay in the local economy. Shifting to a local, lower cost fuel source will also act as an effective hedge against future increases in heating oil costs.

2 COMMUNITY OVERVIEW

Port Graham has a population of 177 (2010 US Census). Its population is primarily Alaska Native (90.4%) has increased 6.6% between 1990 and 2010. Port Graham is a traditional Alutiiq village

relying primarily on subsistence (DEC 2012). Primary employment sources are local tribal/corporation/public sector, the school and health clinic. The U.S. Census Bureau 2006-2010 American Community Survey estimates 32 Port Graham residents as employed; the local unemployment rate in Port Graham is 22.0% with another 44.6% of the population out of the labor force (unemployed and not seeking employment). The average median household income in Port Graham is $18,942.

Port Graham is an unincorporated community. The Regional Native Corporation that covers Port Graham is the Chugach Alaska Corporation. The Village Corporation is the Port Graham Corporation and the Village Council is the Port Graham Village Council. Chugachmiut serves as the regional non-profit corporation for the community.

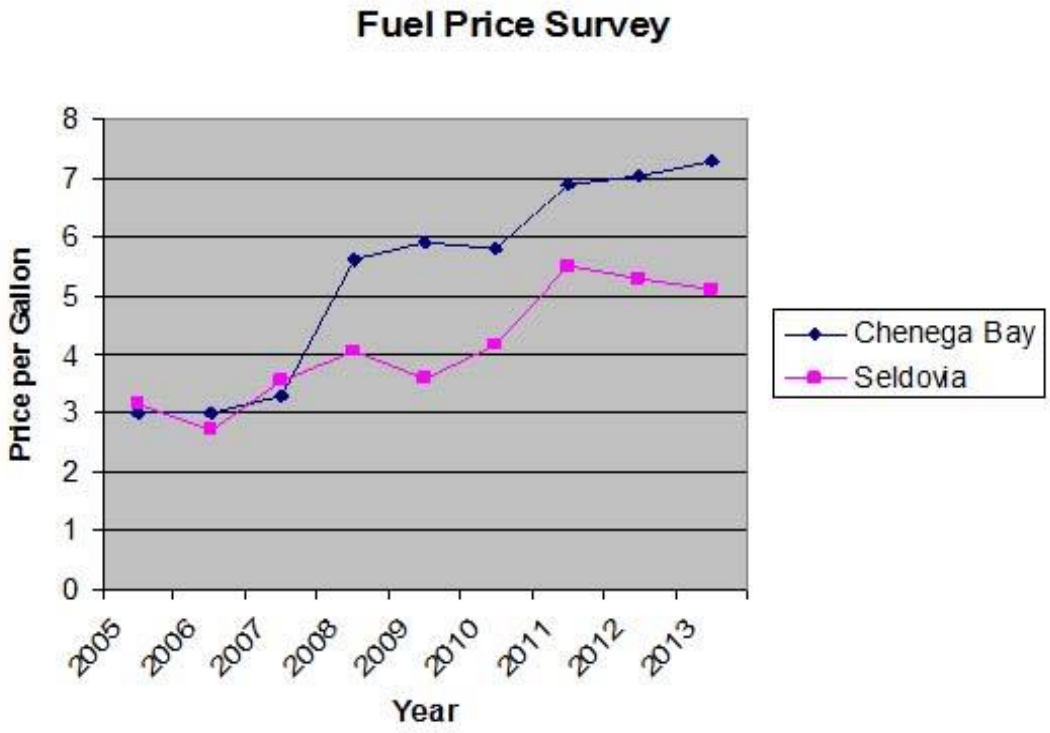
The community is located at the southern end of the Kenai Peninsula on the shore of Port Graham. It is adjacent to Nanwalek (population 287), 7.5 miles southeast of Seldovia and 28 air miles from Homer. Winter temperatures range from 14 to 27 degrees F, summer temperatures vary from 45 to 65 degrees F. Average annual precipitation is 24 inches.

Port Graham is not accessible by road. A state-owned 1,975' long by 45' wide dirt/gravel airstrip is available. The community offers docking facilities. There is a 4-mile trail to Nanwalek. The State of Alaska is in the planning stages for a new airstrip to serve the villages of Nanwalek and Port Graham - the main transportation connection between the villages and Homer and the road system. Construction is slated to begin in 2017 or 2018 once land and right of way acquisition is completed.

All community facilities but one are wood structures with metal roofs and are either on wood, concrete, or concrete block foundations. These buildings are currently heated with diesel-fired, hot-water systems. A sufficient quantity of biomass is available in the forested region surrounding port Graham to supply energy to the village. Over 500,000 green tons of biomass could be accessible from Port graham forested lands with half the availability located within ¼ mile of the existing roadway *(The Potential for Biomass District Energy Production in Chugachmiut Communities,* Energy & Environment Research Center, July 2007 and *Port Graham Biomass Resource Assessment,* Nathan Lojewski, Chugachmiut Forest, January 2013).

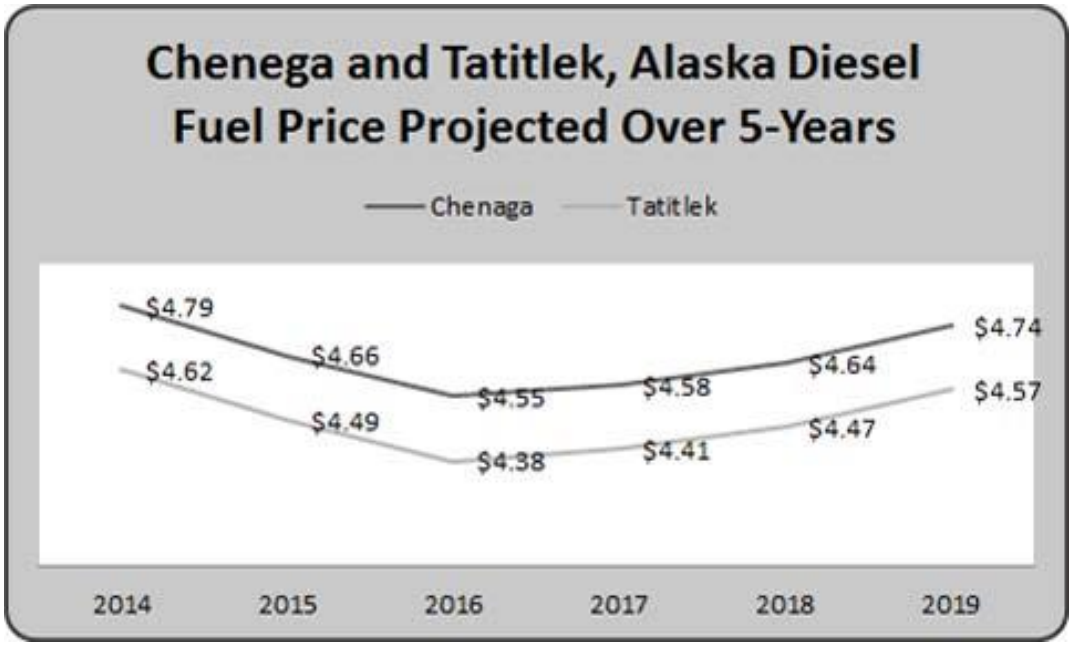
3 COMMUNITY FUEL PRICES/CONSUMPTION

Current fuel prices (2013) in Port Graham are $5.95 per gallon for heating oil; prices have been steadily rising since 2005. Fuel price trends in the Gulf Coast region largely mirror the trends in the average Alaska fuel prices; prices have increased between two and four dollars per gallon over the last eight years (Community & Regional Affairs, Research & Analysis, Fuel Price Survey, 2013). The following table shows historical heating oil prices in two communities in the Gulf Coast region.



In addition to historical fuel cost data, the Institute of Social and Economic Research (ISER) annually produces fuel price projections. The Alaska Fuel Price Projections are developed for the Alaska Energy Authority (AEA) for the purpose of *estimating the potential benefits and costs of renewable energy projects*. These fuel price projections are used to evaluate the economic feasibility of projects, although economic feasibility is only one of many factors of the project evaluation process.

The Alaska Fuel Price projections are a statistical estimation of potential utility avoided fuel prices from 2013 to 2035, based on historic relationships between utility fuel prices and crude oil prices reported by the U.S. Department of Energy, Energy Information Administration (EIA). The report does not contain specific data for Port Graham or Nanwalek; it does contain projections for two other non-road accessible communities in the region that are thought to be representative of Port Grahams' fuel prices/ situation.



The community diesel price projections use a Consumer Price Index average (1985-2012) multiplier of 3% per year. In modeling the economic benefit of the Port Graham biomass project, the same assumptions were used, even prices have increased above 3% in the last five years.

Current year fuel consumption figures (2013) for Tribal and Corporation facilities in the community indicate fuel usage of 6310 gallons for the year at a cost of $5.95 gallon.

Windy Bay Services LLC. (Heating Fuel)					
Building	**Clinic**	**Council**	**Safety**	**Corporation**	
November			$722	$1,363	
December	$1,478	$2,023			
January	$2,996	$3,676		$1,363	
February		$2,220		$1,488	
March		$1,489	$707	$1,230	
April	$1,480	$710	$749		
May	$2,255	$7,662	$3,755		
June					
July					
August					
September					
October					
TOTAL:	**$8,208**	**$17,778**	**$5,933**	**$5,444**	
			6310.0	GALLONS	
			$6	PER GALLON	
			$37,545	TOTAL COST	

Historically, fuel consumption has remained flat while prices have steadily climbed since 2005.

4 PROJECT BACKGROUND

Port Graham is moving forward to improve economic conditions in the community by reducing the cost of living, utilizing local lands and resources, and reducing the cost of energy of tribal facilities – thereby allowing limited financial resources to be spent on programs, not utilities. There is a significant timber resource in close proximity to the community that is road accessible. The forest resource is owned by Native corporations or located on privately held Native Allotments; The Port Graham Village Council and Port Graham Corporation are large landowners in the area. The community desires to maintain their cultural association with the land and owners; Native Allotments are generally underutilized for economic development or timber and

there is a need to increase the cash economy in the village. Some land owners are content with current utilization.

In 2005, Port Graham began a process to identify the best technologies and systems to heat village structures. In 2006, Port Graham was awarded a U.S Department of Energy (DOE) Tribal Energy Program grant to conduct a biomass feasibility study to analyze the biomass resource data, evaluate site selection and energy load, evaluate cogeneration technology, and determine the engineering economics. The feasibility study identified community objectives, generally assessed the biomass resource and assessed community heat loads, both residential and community facilities. Technologies were evaluated at a high level, including looking at wood chips, multiple small systems and a district heat loop.

In 2007 a report, *The Potential for Biomass District Energy Production in Chugachmiut Communities* was prepared by Energy & Environmental Research Center. The study examined the economic and technical feasibility for implementing biomass energy system(s). The authors performed load evaluation, resource data analysis, reviewed energy and cogeneration technology and conducted an economic analysis for the tribe. At the time the study was conducted woody biomass was considered a viable option, as was fish oil from fishery activities. The report concluded the most economical and technically viable options for the community was fish-oil diesel blended fuel and indoor wood boilers. Fishery activities have since ceased, making a fish oil-diesel blend unnecessary and significantly reducing the amount of diesel that could be displaced through the use of woody biomass.

The community of Port Graham also developed an Integrated Resource Management Plan (IRMP) in 2006 and further developed the policies to implement the IRMP in 2008. The IRMP represents a holistic approach to resource management that recognizes that land, sea, sea coasts, freshwater systems, their people and multiple land uses are all interconnected. The Port Graham IRMP explicitly supports biomass systems for the community. Policy statements include:

- Implement innovative options to reduce energy costs
- Maximize natural resource management to ensure we have a forest in 100 years
- Community will focus on developing a biomass energy facility.

During the course of evaluating the best system for Port Graham, the community considered the technical challenges of environmental concerns especially those related to air quality and the

health impact of smoke from inefficient heating systems. Biomass is by nature a high-volume fuel requiring handling by personnel or equipment and protected storage areas, both issues were considered. In addition the members of the community evaluated systems against the backdrop of sustainability of forest resources.

5 DESCRIPTION OF PROJECT

After a careful planning process, Port Graham decided to move forward with a hydronic system with a district heating loop. The hydronic system contains a large boiler that will burn cordwood to heat liquid (hot water) that is distributed through insulated piping. The hot water will be distributed out to the Anesia Anahonak Moonin Health and Dental Clinic, the Port Graham Village Council offices, the Port Graham Public Safety Building/Fire Department and the Port Graham Corporation Office Building which also houses the Port Graham museum and Head Start. The hot water is then returned to the boiler for re-heating. The project design is based on installation of a WHS 3200 GARN boiler for the heating plant; it is rated at 700,000 Btu output with a tested efficiency of 85%. It has a 3200 gallon capacity of heated water storage. The wood-fired system is designed as the primary means to deliver heat to the four community buildings using cordwood harvested from road accessible lands in close proximity to the core area of the community. The GARN WHS 3200 has a recommended wood length of 24" to 42" with a recommended wood diameter of 4" to 12".

Fuel Demand	HEATING DEMAND ANNUAL				
	AREA	BTU'S	MMBTU	DIESEL	ANNUAL
BUILDING	SQ FEET	HR	/YEAR	GALLON	COST($5.95*)
Anesia Anahonak Moonin Clinic	3330	260,000	260	1380	$8.211
Tribal Council Building	3600	234,000	234	2988	$17,779
Corporation Office	1600	104.000104	945	$ 5,623	
Public Safety Buildings	900	50,000	50	997	$ 5,932
Totals	9,430	648,000	648	6310	$37,545

A significant advantage to a cordwood boiler is that they are batch-loaded with seasoned cordwood. As a result, very little infrastructure is needed to manufacture or handle the heating fuel. Covered storage is required for the cordwood in order to facilitate seasoning of the wood. Wood storage for the community should hold sufficient material to supply energy needs projected from historical and current usage for 2 years and 30% more than the average need. This will allow the feedstock 1 year to dry to achieve the seasoned moisture rating of about 20% for Sitka spruce in the Kenai Peninsula. Green wood is typically 40% or greater, which is too wet for efficient combustion or gasification, generating a smoky exhaust, increased ash production and reduced heat production. The design considers the potential for colder than average temperatures during winter months. Storage size about 30% above the average estimated feedstock requirement is generally recommended for similar projects.

Port Graham Tribal Council has identified two lots (owned by the Council) for wood storage. One, approximately 6.5 acres and roughly one mile by road from the site of the GARN boiler, will be used for long-term storage. It is of sufficient size to store multiple years' supply of wood; the project requires an estimated 125 bone dry tons (100 cords) per year. The lot where the GARN boiler will be situated is on a 2.9 acre lot that also includes the facilities to be heated with the biomass system. The GARN building will be located on the far northwest corner, close to the lot line. Right next to the Garn building is the 1/3 acre lot owned by the council – it is roughly 170 x 80 feet and will be used to stage 1-2 cords wood for daily/weekly use.

Space heat for the community facilities is currently generated through an oil-fueled boiler hot water heating system. The existing system will remain in place as a back-up/fail-safe ensuring the facilities are heated at all times. Experience with other biomass systems in Alaska indicates the biomass system will displace approximately 85% of fuel oil currently used.

6 PORT GRAHAM BIOMASS RESOURCE ASSESSMENT

With any proposed woody biomass energy project, a number of basic questions arise concerning the biomass supply including:

- How much biomass is there in the vicinity of the community?
- What are the characteristics of the biomass (size, species, and quality)?
- Where is the resource located?
- Who owns the resource?
- What are the costs associated with getting the resource to an energy facility?
- What management restrictions (if any) are there are on the resource?

- Considering growth rates, cover type conversions, and other factors, what is the sustainability of the resource?
- How large an array of biomass energy facilities could be economically supported on a sustainable basis by the local biomass resource?

Chugachmiut Forestry recently completed the Port Graham Biomass Resource Assessment (January 2013, Nathan Lojewski, CF, Forestry Manager). The purpose of the assessment was to determine the maximum sustainable harvest of biomass fuel, or maximum annual allowable cut (AAC) from the Port Graham vicinity across all land ownerships. The report concluded that the Port Graham vicinity has abundant forest resources, a developed forest road system, and is an ideal location for biomass energy projects. With 16, 786 acres of accessible timberland and the potential to add more, Port Graham has enough timber resources to meet its energy needs. The recommended AAC range is 30 times greater than the projected need for the GARN boiler. Information for the assessment was derived from the Chugach Region 2011 Forest Inventory which considered lands with less than a 35% slope, outside of water buffers, readily lending themselves to road access and suitable for long-term forest land management.

Typically (outside Alaska) biomass resources are thought of as residue from logging or other forest activities. Since there is no forest industry in Port Graham, a biomass system requires harvesting strictly for the system. The forest resource surrounding Port Graham consists of immature forest (9623 acres) and mature timberland (7163 acres). Wood to be harvested will be Sitka Spruce; generally there are 150-200 trees per acre with an average diameter of 16". The Alaska Energy Authority estimates Sitka Spruce to contain 19.3-21.7 MMBtu/cord with a dry cord weight of 1960-2520 pounds and a green cord weight of 3190-4100 pounds. The moisture content of dry weight is estimated at 12% with 40-60% for green.

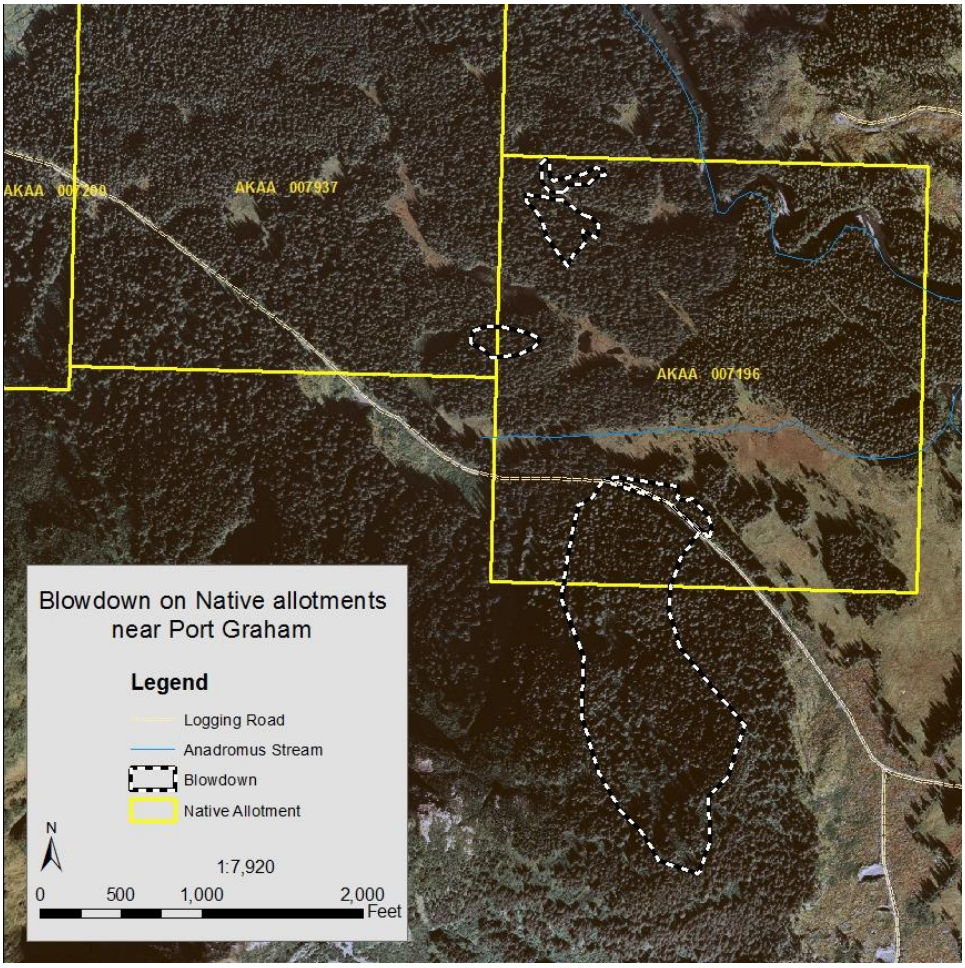
The majority of the resource is accessible from the existing road system (10,758 BDT/Year) and 99% of the resource is owned by Native Corporations or located on privately held Native Allotments; Port Graham Corporation and English Bay Corporation are the two largest landowners in the Port Graham vicinity. The Port Graham Tribal Council owns approximately 369 acres including and immediately surrounding the town site which has a timber resource as well and is located in close proximity to the site of the facilities included in the project.

Costs associated with getting the resource to the GARN site are estimated to be in the range of $55.00 –$ 65.00 per ton, depending on which option the community chooses to use for harvesting methods. The cost of getting the resource to the site will allow the Tribal Council to displace approximately 5365 gallons of fuel oil per year (see detailed operating costs in Project economics section).

Accessing the plentiful timber resource for a biomass project does not present any specific forest management issues, although determining the maximum sustainable harvest of biomass fuel, or the maximum allowable cut from the Port Graham vicinity must be considered. The Port Graham Village Council has stated goals of sustainably harvesting timber; the biomass resource assessment conducted by Chugachmiut makes recommendations for the maximum Annual Allowable Cut (AAC) in keeping with Tribal policies. The recommended range of the AAC is between 3,259 and 6,578 BDT. This is a conservative estimate in order to avoid accidental unsustainable biomass harvests in the area. The lower end estimate includes only mature forest, leaving out growth from the 9,623 acre immature forest, and reserving 40% of total volume for higher value timber products. A more moderate approach would be to reserve 40% of the total forest volume for higher value timber product and limit the AAC to available mature timber for the first 50 years, resulting in an AAC of 6,578 BDT. Regardless of which AAC is chosen by the community, the range should be updated periodically to account for the effects of natural forest disturbances and forest growth.

In addition to standing timber resources, the Port Graham area has two other potential woody biomass resources – substantial windthrow located on Native Allotment lands and timber cleared from the upcoming airport project.

The wind thrown timber resources is estimated to be 139 acres. Generally, harvest cost in blown down timber is higher than that of standing timber. Windthrow timber offers the advantage of lower stumpage costs and utilizing a resource that has no other use. A recent timber sale in Interior Alaska sold spruce saw logs for $18.31/green ton, birch fuel cordwood for $10.01/green ton and blow down timber for $1/ton. Location and cost of operating in blow down influenced the sale price. Although the sale is in a different region than Port Graham, it can be expected that the price range/differential will be similar in the South Central region.



The new airport is in the design phase, and as part of the project, a roughly four mile all season road will be constructed linking Port Graham and the neighboring community of Nanwalek. In addition to providing access to previously inaccessible timberlands, the clearing of the road and airport itself will provide woody biomass suitable for the Port Graham project. The Environmental Assessment, Nanwalek and Port Graham Airport Project (August 2013) estimates tree clearing would include approximately 157 acres to ensure the safety of aircraft approaches, and construction of the proposed airport and access roads. Acreage in the lands surrounding Port Graham generally yield 150- 200 trees per acre; assuming most of the timber is salvageable, it will provide a biomass resources of 88 BDT per acre of mature Sitka Spruce, which makes up the majority of the vegetation type in the project area. Costs to the Port Graham Village Council would consist of transportation, stacking and splitting the wood, a lower cost than harvesting standing timber.

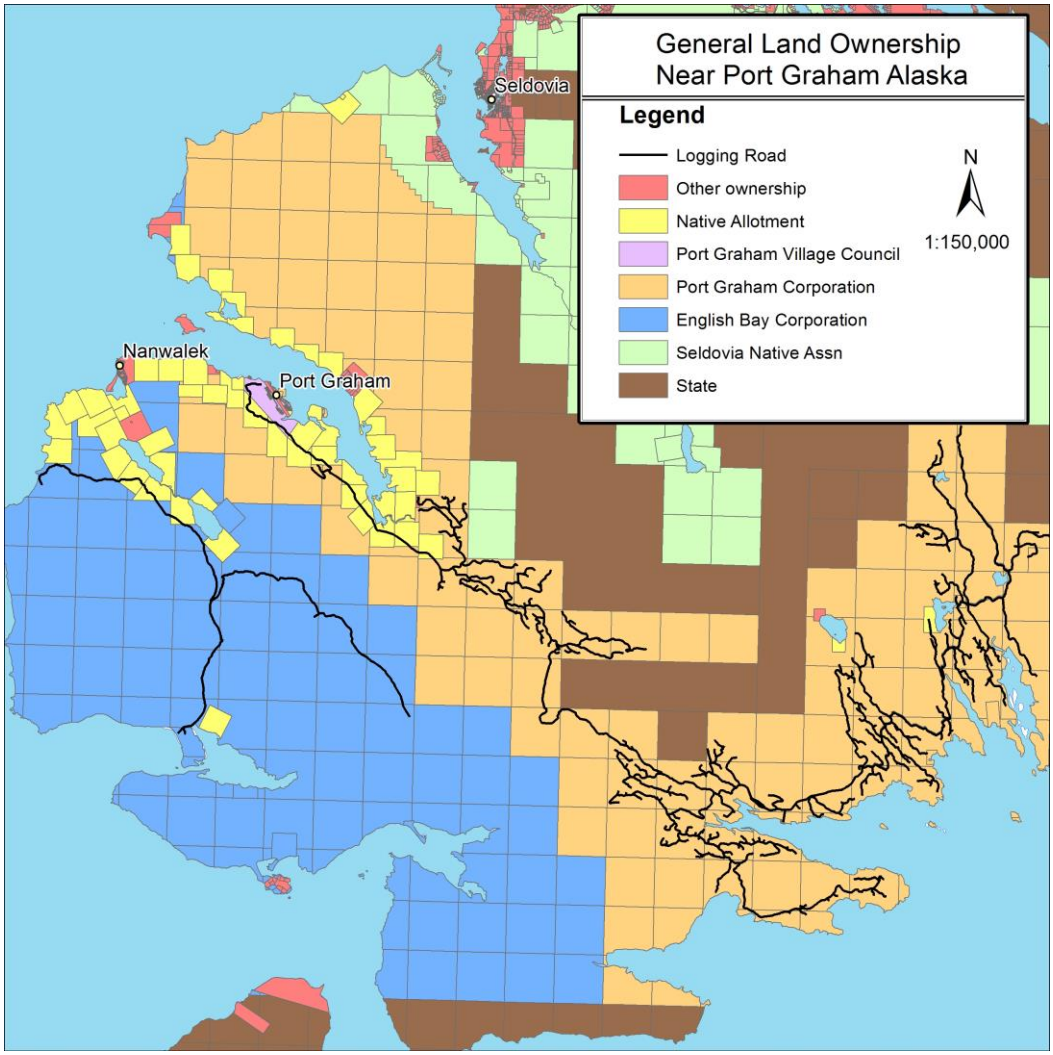
7 LAND OWNERSHIP

Timber resources being considered for the Port Graham biomass project are those available within ¼ mile of an existing roadway. Land ownership in the identified vicinities are largely Native Allotment parcels and Port Graham Corporation lands. There are eleven Native Allotment parcels that are currently road accessible; the average size is 160 acres. Owners have varied goals and objectives for their land, ranging from preservation to economic development. The blow down timber that has been identified as a potential source for biomass for the project is located on Native Allotment lands.

Port Graham Corporation is a for-profit village corporation that is one of the two largest landowners in the area (English Bay Corporation of Nanwalek being the second). The corporation selected lands that have potential for economic development including commercial timber land, mineral estates as well as lands that have potential for tourism, and lands of cultural and historical importance to the Alutiiq people, with an eye towards providing a return to its shareholders.

Participation of Native Allotment owners and the Port Graham Corporation will be critical to the long-term success of the project as all of the timber resource is located on these lands. The Port Graham Village Council also owns land approximately 250 acres of timber lands directly adjacent to Port Graham townsite. This timber could also be used for the biomass project if the Council is willing to harvest timber directly adjacent to Port Graham rather than continue to provide a sight buffer.

Native Allotment parcels accessible by road cover 1,339 acres with a maximum Annual Allowable Cut (AAC) of 1,009 BDT. The Port Graham Corporation has 16,024 road accessible acres with an AAC of 7,651 BDT.



8 PROJECT ECONOMICS

Although economic feasibility is only one of many factors of the project evaluation process, accurately estimating the potential benefits and costs of a renewable energy project is very important to the overall project success. The Port Graham Biomass Project enjoys many positive factors - an ample, road accessible supply of biomass resources, a community that supports the concept of renewable energy projects and a community that is committed to utilizing its resources - heating facilities with a local energy source rather than paying an outside entity to ship costly fuel. In order for the community to plan for its future, it must have an estimate of the costs involved in operating the facility for its total life cycle and compare it to existing non-renewable energy systems so there are no financial surprises.

This section will examine the cost of woody biomass using the least capital intensive harvest method, the operating costs of the proposed GARN boiler system versus the existing fuel oil burners and the overall project cost over its life cycle. In addition, the benefit /cost ratio and simple payback will be calculated and charted to show the sensitivities of the cost of wood for the biomass system effect the overall project economics.

As is the case for most biomass projects, the cost of the woody biomass resource is of particular importance to the overall project economics. The two basic cost components are stumpage – a price on timber calculated in volume (cords or tons) – and harvest costs. And both components have a number of variables associated with the cost. Stumpage costs can be assessed at market value (based on recent timber sales) or modified to meet community goals, either to support renewable energy projects that infuse cash into the local economy through paying stumpage fees. With varied landowner goals, the Port Graham project is particularly sensitive to the cost per ton of wood.

In general, cost factors are highly dependent on the harvest method used. For the purpose of calculating project economics, the manual felling system of harvesting will be used with a total requirement of 100 cords per year (or 125 BDT/year). Although mechanized logging systems result in higher productivity, the Garn system to be utilized in Port graham requires only 100 cords/annually, so a manual system is likely the most cost effective (the Port Graham Biomass Project Harvest and Operations Plan explores various logging systems and their relative productivity and cost in more detail). Stumpage price is based on a recent timber appraisal near Port Graham in 2012 the price was $35/MBF or $17.50/cord. Extrapolating from a West Virginia study on cost analysis of harvesting systems, an assumption was made:

- Three man crew working 10 hour days with 8 productive hours, the crew could produce 8 MBF/day or roughly 16/cords/day
- 100 cords annual need/16 cords/day = 6.25 days of felling and yarding
- Port Graham Tribal Council wages - $12.00/hour with a 100% benefit rate (high benefit rate estimated because of anticipated workers compensation rates) = $24.00/hour
- Three person crew @ $240.00 each/day x 3 x 6.25 days = $4500.00
- Plus a 15% contingency cost = $675.00
- $5175.00 equals direct logging cost

FIGURE 1: Year 1 Wood Procurement Costs

Breakdown of Wood Procurement Costs		
Cost Item	**$ per Cord**	**$ per Ton**
Logging Cost - Direct		
Falling and Bucking (cutting)	$15.00	$12.00
Skidding (wood-to-road)	$14.37	$11.70
Sorting and Loading (grading)	$22.38	$17.90
	$51.75	**$41.40**
Logging Costs - Overhead		
General Burden	$0.00	$0.00
Mobilization (travel)	$0.00	$0.00
Camp (housing)	$0.00	$0.00
	$5.00	**$4.00**
Transportation/Handling to Village		
	$4.75	**$3.80**
Development and Maintenance		
Temporary Roads	$0.00	$0.00
Temporary Bulkhead (dock)	$0.00	$0.00
Erosion Control	$1.00	$0.80
Road Maintenance	$0.00	$0.00
Slash Disposal (limbs)	$1.00	$0.80
	$2.00	**$1.60**
Harvest cost	**$68.50**	**$50.80**
Market Value (base price paid to owne	**$17.50**	**$14.00**
Total Wood Cost	**$81.00**	**$64.80**

9 CALCULATION OF OPERATING COSTS FOR THE GARN

The Port Graham Biomass Project is designed to use the largest sized boiler GARN makes – the WHS 3200. In order to estimate operating costs of the GARN, the GARN representatives in both Alaska and Vermont were contacted. They in turn found a greenhouse operation off the coast of Maine that runs a GARN 3200 using spruce blowdown as the source of fuel. They are reported to

be "very happy" with that particular model GARN boiler – they burn approximately 100 cords/year and displace 12,000 gallons of oil (the cost of oil is $5+/gallon). They report that using wet wood significantly reduces the flue gas temps (400 degrees) and dry wood is optimum (600 degrees).

There are many variables in each biomass system, but in order to estimate operating costs for the Port Graham project, other entities experience was examined. During periods of maximum load of 600,000 Btu/hour, the operator will have to fire the boiler approximately every two hours. At that firing rate, the operator will have to remove the ash daily. On the coldest days, the operator will spend one hour and fifteen minutes firing the boiler and cleaning ash. This rate will only occur when the weather is coldest. Finishing the day with a full charge will allow a longer holdover and cool ash in the morning. Figures used to calculate operating cost assume an operator will need two/hours/day for 365 days of the year, a conservative estimate given the GARN representatives estimates. The Tribal Council pays their existing Maintenance Worker $12.00/hour with a benefit rate of 20%, making it $14.40/hour. The chart below uses $10,512 for annual operating and maintenance costs of the GARN system

2/hours/day @ $14.40 x 365 days/year= $10,512

O&M Costs Fuel Oil			**O&M Costs: Biomass + Fuel Oil (supplement)**			
Oil		$37,545	**Biomass**			
Labor		$ 810	Wood Fuel		$ 8,125	
Supplies		$ 250	Labor		$10,512	
			Preventative Maintenance supplies		$ 66	
			Oil		$ 5,635	
			Labor		$ 405	
			Supplies		$ 250	
					Annual Savings	
Total Annual O&M Costs (accrual basis)		**$ 40,105**	Total Annual O&M Costs (accrual basis)		**$ 24,993**	**$15,112.00**

It should be noted that the project will provide a benefit (reduced heating costs) to the Port Graham Corporation, while the Port Graham Village Council shoulders the cost and

responsibilities of the woody biomass system. A heating sales agreement should be negotiated for a portion of the avoided cost the corporation will realize (see Operations plan for recommended agreements terms). The sales agreement will offset a portion of the costs of running the system. Those costs are not figured in the above table or economic modeling, but will favorably impact the sustainability of the project.

The following chart indicates the Benefit /Cost Ratio, the Simple Payback and how each is effected by the cost of cord wood. A benefit-cost ratio (BCR) is an indicator, used in the formal discipline of cost-benefit analysis, which attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. Benefit cost ratio (BCR) takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. The higher the BCR the better the investment. General rule of thumb is that if the benefit is higher than the cost the project is a good investment.

FIGURE 1: Green Wood Purchasing Scenarios

Scenario 1: Single Wood Price, Life of the Project.	Price of Wood ($/green ton)			
	Current Model ($65)	$70	$75	$80
Net Profit	$ 130,814	$ 113,874	$ 97,586	$ 81,298
Funds to Community	$ 38,381	$ 41,461	$ 44,422	$ 47,384
B/C Ratio	1.16	1.10	1.05	0.99
Simple Payback (Avg annual savings)	15.4	16.2	17.1	18.0

Scenario 2: Blowdown Price for First 10 years.	Price of Wood ($/green ton)			
	$5 / $65	$5 / $70	$5 / $75	$5 / $80
Net Profit	$ 209,500	$ 199,801	$ 190,102	$ 180,403
Funds to Community	$ 24,074	$ 25,837	$ 27,601	$ 29,364
B/C Ratio	1.48	1.45	1.43	1.40
Simple Payback (Avg annual savings)	12.5	12.8	13.1	13.5

FIGURE 2: Modeled Outputs under Primary Scenario

OUTPUTS		
Annual Displaced Petroleum Fuel (gal/year)		5,365
Total Lifetime Displaced Petroleum Fuel (gal)		134,125
Annual Avoided CO2 (tonnes/year)		54.5
Total Lifetime Avoided CO2 (tonnes)		1,361.4
NPV Benefits	$	230,010
NPV Capital Costs	$	198,543
NPV Net Benefit	$	31,467
Net Profit (All dollars)	$	130,814
Funds to Community (All dollars)	$	38,381
Benefit / Cost Ratio (B/C)		1.16
Simple Payback (Avg annual savings)		15.4

An energy investment's Simple Payback Period is the amount of time it will take to recover the initial investment (capital cost) in energy savings, dividing the initial installed cost by the annual energy cost savings. For example, an energy-saving measure that costs $5000 and saves $2500 per year has a Simple Payback of $5000 divided by $2500 or two years. Simple Payback is useful for making ballpark estimates of how long it will take to recoup an initial investment.

The following table calculates the project replacement costs and the required capital replacement fund balances. It assumes a 25 year project life, inflation rate of 3%, and a reinvestment rate of 4%.

Equivalent Annual Cycle Cost

Inflation Rate:	3%		Reinvestment Rate:	4%	
Project Replacement Costs			**Capital Replacement Fund Balance**		
Year	Total Assets Inflated Cost	10% of Total Asset Cost	Start of Year Balance	Annual Deposit	Interest Earnings	End of Year Balance
1	$210,634	$21,063	$0	$1,028	$0	$1,028
2	$216,953	$21,695	$1,028	$1,028	$41	$2,097
3	$223,462	$22,346	$2,097	$1,028	$84	$3,209
4	$230,165	$23,017	$3,209	$1,028	$128	$4,366
5	$237,070	$23,707	$4,366	$1,028	$175	$5,569
6	$244,183	$24,418	$5,569	$1,028	$223	$6,820
7	$251,508	$25,151	$6,820	$1,028	$273	$8,121
8	$259,053	$25,905	$8,121	$1,028	$325	$9,473
9	$266,825	$26,682	$9,473	$1,028	$379	$10,881
10	$274,830	$27,483	$10,881	$1,028	$435	$12,344
11	$283,074	$28,307	$12,344	$1,028	$494	$13,866
12	$291,567	$29,157	$13,866	$1,028	$555	$15,449
13	$300,314	$30,031	$15,449	$1,028	$618	$17,095
14	$309,323	$30,932	$17,095	$1,028	$684	$18,807
15	$318,603	$31,860	$18,807	$1,028	$752	$20,587
16	$328,161	$32,816	$20,587	$1,028	$823	$22,439
17	$338,006	$33,801	$22,439	$1,028	$898	$24,364
18	$348,146	$34,815	$24,364	$1,028	$975	$26,367
19	$358,590	$35,859	$26,367	$1,028	$1,055	$28,450
20	$369,348	$36,935	$28,450	$1,028	$1,138	$30,616
21	$380,428	$38,043	$30,616	$1,028	$1,225	$32,869
22	$391,841	$39,184	$32,869	$1,028	$1,315	$35,211
23	$403,597	$40,360	$35,211	$1,028	$1,408	$37,648
24	$415,704	$41,570	$37,648	$1,028	$1,506	$40,182
25	$428,176	$42,818	$40,182	$1,028	$1,607	$42,818

10 BIOMASS OPERATIONS PLAN

The Port Graham Village Council, working with Chugachmiut, will operate a HELE (high energy low emission) hydronic heating system with a district heating loop and a wood harvesting operation to support it. The project design is based on installation of a WHS 3200 GARN boiler for the heating plant. The wood-fired system is designed as the primary means to deliver heat to four community buildings using cordwood harvested from road accessible lands in close proximity to the facilities utilizing the new system.

The project requires an estimated 125 bone dry tons (100 cords) per year. Mature Sitka Spruce which makes up the majority of the vegetation type in the project area will be harvested. In order to produce this tonnage, in the first five years of operation, the Village Council will access approximately 78 acres of blown down trees. A secondary source of woody biomass fuel to be utilized is the spruce resulting from the tree clearing of approximately 157 acres (at a rate of 88 BDT per acre) that will occur as part of the construction of the new airport. The majority of the fuel will be consumed during the cold winter months of November through March. A one year supply of wood will be maintained at the wood storage lot, with 3-4 cords stored at the site of the boiler facility.

The harvest operations are estimated to begin in 2015, or immediately after construction funding is secured. Harvested timber will required a one year drying period in order for the biomass system to operate most efficiently. The recommended harvest method is manual felling and cable skidding. Manual felling will require the purchase of some equipment; two chain saws, a small log splitter and a log trailer. In addition, the purchase of a cable skidder (preferably used) will be required should the Council choose that method of harvesting.

11 STAFFING AND TRAINING

There are two staffing components for the new biomass system – ongoing operations and maintenance of the GARN boiler and harvesting the wood for the boiler. The operation and maintenance of the boiler will require daily attention during the coldest times of the year and the performance of more occasional tasks during the summer months.

Operations and Maintenance. The GARN 3200 has a combustion chamber length of 50" and a combustion chamber diameter of 40". Recommended wood length is 24" to 42" and recommended wood diameter is 4" to 12". The boiler is manually fed and manually started. The primary control function of the GARN is combustion control – simply ensuring that the combustion air is controlled such that the wood burns hot and clean. If more capacity is needed to meet load, the operator can simply conduct more "burns" per day. When less capacity is needed, fewer burns are performed. There is very little maintenance required of a GARN boiler. The wood is burned in the primary combustion chamber, in the secondary combustion chamber only gasses are burned. Ash removal is required after burning 1-2 cords of wood. GARN representatives estimate ash removal time at 15 minutes per removal. Three to four cords of dry spruce will be stored at the site of the boiler building. Wood will be transported from the larger wood storage lot (approximately one mile away) as needed.

The Port Graham Village Council currently employs a part –time Office Building and General Maintenance position that reports to the Tribal Administrator. The position job duties can be easily expanded, as can the number of hours (see job description in Appendix 4). An additional two hours/day for 365 days/year were added to the position costs in the Project Economics section. Tasks for the position related to maintenance and operations of the biomass system should include:

- Load combustion chamber with stick wood
- Manually start fire
- Clean out ash from combustion chamber as needed
- Move/load wood from wood storage lot to boiler facility lot as needed
- Perform minor routine maintenance on GARN boiler

After installation and prior to operations, a training class should be conducted in Port Graham. The GARN dealer in Alaska (Alaskan Heat Technologies) can provide the training; it should be attended by staff directly involved with the operation of the GARN and other staff that might be called in as backup should the primary operator be absent.

Wood Harvesting. Production and cost are major factors in choosing a harvesting method. Manual harvesting systems have a lower capital investment than mechanized harvesting systems; manual systems have lower output of volume. Mechanized harvesting systems have a much higher

cost per hour to operate, although its cost per unit volume aren't affected because of high output volume. Conversely, manual harvesting systems have lower costs per hour and a higher cost per unit because of a lower output volume. Because of the relatively low volume of wood required by the Port Graham Biomass Project, the recommended harvest method is the manual harvesting system – the manual felling system consists of felling with a chain saw and skidding (dragging) with a cable skidder.

The Port Graham Village Council has the administrative structure in place to hire a temporary, three-man crew to harvest the necessary woody biomass for the project. Based on productivity estimates, a three man crew can produce the required 100 cords of wood in approximately 12.5 days. In addition to the standard benefit/overhead rate of 20%, an additional 40% benefit rate is anticipated due to the high cost of workers compensation for logging activities. The Village Council does not currently have job descriptions for timber harvesting positions but the following tasks will apply to the positions:

- Remove or trim branches and tree tops
- Load and Transport logs
- Clear area around intended fall of each tree
- Plan the tree felling and bucking (sawing the logs)
- Operate manual and machine saws to fell and buck trees
- Operate machinery such as loading machines, excavators and bull dozers
- Maintain equipment
- Maintain strict occupational health and safety requirements

Personal requirements are as follows:

- Must have the ability to undertake manual and heavy work
- Must be observant and methodical
- Must have good communications skills
- Must enjoy outdoor work
- Must enjoy working in teams
- Must be alert and safety-conscious

Training for the temporary crew will consist of safety training and operations training on the equipment to be used.

12 EQUIPMENT REQUIREMENTS

Within the manual felling category of harvesting timber, there are still a number of variables, especially in regards to equipment. The Port Graham GARN Boiler Harvest Plan recommends the use/purchase of a cable skidder (a type of heavy vehicle used for pulling cut trees out of a forest) and a small self-loading log trailer. The logging trailer can be towed with existing vehicles owned by the Village Council or the Village Corporation. It would be used to haul logs from the harvest site to the wood storage area and subsequently, down to the boiler site. The cost estimates for the two pieces of logging equipment from $35,000 - $62,000.

EQUIPMENT TYPE	DESCRIPTION	USED	NEW
Small Cable Skidder	John Deer 440, 540, or equivalent	$15,000-40,000	
Chain Saw (2 minimum)	Stihl 460 Chain Saw		$1,200
Log Trailer	Hakmet, Nokka, or similar		$20,000-$40,000
Small log splitter	20+ ton unit capable of splitting 4ft lengths		$1,500 - $5,000

While purchasing the equipment is optimum, it also represents a significant capital outlay for a logging operation that occurs twelve days/year. The Port Graham Village Council has a grader that could be used for pulling logs and a trailer that measures 25.9' in length by 8.6' wide. The Village Council also owns a flatbed truck with knuckle crane with a rated lift capacity of 2000 pounds. Windy Bay Services (owned by Port Graham Corporation) owns heavy equipment that is available for rent – either with or without an operator. Rates without an operator for a backhoe are

$125/hour of $715/day, with an operator the rates are $170/hour and $1015/day respectively. Dozer rates are slightly higher.

Regardless of which large equipment option is pursued, at a minimum, two chainsaw and small log splitter will most likely need to be purchased, as well as appropriate safety equipment for the operation of a chainsaw.

13 PERMITS REQUIRED

Biomass systems are relatively easy to permit. In the case of Port Graham, there are no required permits from the Kenai Peninsula Borough (telecom, June 2014). There is a requirement for a State of Alaska, Department of Public Safety, Division of Fire and Life Safety plan review for fire and life safety requirements. An application for Fire and Life Safety Plan Review (www.akburny.com) must be completed and submitted prior to construction of the project. There is a one-page form provided by the department; applicable documents signed by a registered design professional are required:

- Scaled plot plan: show distance to property lines and existing buildings
- Structural Drawings: design criteria, connections
- Architectural Drawings: interior, exterior wall details, means of egress, fire extinguisher information
- Mechanical Drawings: hood and duct, fuel tank size and location
- Electrical Drawings: emergency lighting, exit signs
- Fire Protection Systems: automatic sprinklers, hood suppression, fire alarm
- Fire Department Access Letter: access and fire flow approval and notification

Other permit requirement are related to timber harvesting – consultation with the Alaska Department of Fish & Game is required when harvesting operations are in close proximity or actually or cross anadromous waters. In addition, the Kenai Kodiak area forestry office (Soldotna) should be contacted prior to any harvesting activities.

Although not a permit requirement, when harvesting timber on Native Allotment or Port Graham Corporation lands, a timber sales agreement needs to be negotiated and executed.

14 FINANCIAL AND OTHER RESPONSIBILITIES

The owner and primary operator of the Port Graham Biomass Project is the Port Graham Village Council. Port Graham Village Council will be responsible for the use, day-to-day operations and the long-term maintenance of the biomass boiler, the district heat loop and procuring adequate cord wood to fuel the system.

The Project will provide heat to Village Council facilities and to Port Graham Corporation facilities (Port Graham Corporation Office Building which also houses the Port Graham museum and Head Start). As a result of the project, the Corporation will enjoy a reduction in fuel costs of approximately 85%, or $4780 per year (2013 usage of 945 gallons x $5.95/gallon) with no attendant costs or responsibilities. The Port graham Village Council should negotiate a sales agreement with the Port Graham Corporation for the purchase of heat through the district heat loop. Providing payment for the purchase of fuel/heat will increase the sustainability of the project for the Council while providing a cost reduction to the Corporation.

There are several methods to calculate an agreement and the method selected is a matter of policy to be decided by the Board of the Port Graham Village Council. Perhaps the simplest method is to charge the Corporation a percentage of cost of heat provided through the biomass system. Estimating the Corporations share can be based on heating oil usage. For example:

- Total cost of biomass heat for all facilities= $24,993.00
- Village Corporation consumes 945 gallons/per year out of a total of 6310 gallons/per year, or 15%
- Actual cost or charge to the corporation is $24,993.00 x 15% = $3748.95

Another method is to calculate the cost of the Corporation's share of the biomass heat is to make the calculation based on Demand BTU's Hour which is calculated based on heating area square feet.

- Total biomass system demand BTU's/HR = 648,000
- Corporation facilities demand BTU's /HR = 104,000 or 16%
- Total cost of biomass heat for all facilities on system = $24,993.00
- $24,993.00 x 16% = $3999.00

The Council can adjust the rate to the Corporation in keeping with policy decisions rather than based on a formula. Currently operating costs are estimates, it will be important to examine actual costs after the first year of operations so actual expenditures and savings can be examined and any charges adjusted.

15 APPENDIX 1

BASE MODEL FUEL ASSUMPTIONS:

- Base Fuel Price (not including Carbon Pricing) in 2011$ after a four year period of steep decline grows at (per barrel): $0.05, $0.10, $0.15, $0.25, $0.30, $0.30 ...
- Base Fuel Price (not including Carbon Pricing) is converted from 2011$ to 2012$ using 2.07%
- Heating Fuel Premium grows at 2.07%
- Per the 2013 report[1]:
    - Fuel oil price projection will follow the EIA long-term low estimate of crude oil price per barrel (EIA 50/50 Brent/West Texas Intermediate).
        - EIA forecast assumptions:
            - "Low prices result from a combination of low demand for petroleum and other liquid fuels in the non-OECD nations and higher global supply.
            - Lower demand is measured by lower economic growth relative to the Reference case, with GDP growth in non-OECD region being 1.1 percent lower on average in each projection year beginning 2013.
            - OPEC increases its market share to 49 percent, and the costs of other liquids production technologies are lower than in the Reference case.
            - Crude oil prices fall to $75 per barrel (2011 dollars) in 2040."
    - Heating Fuel Premium based on ISER – EIA 2013 Annual Energy Outlook crude oil forecast (EIA 50/50 Brent/West Texas Intermediate mid estimate). This is modified by a Consumer Price Index average (1985 – 2012) multiplier of 3% per year to bring older values to 2012$.
    - The Alaska Fuel Price projections are a statistical estimation of potential utility avoided fuel prices from 2013 to 2035, based on historic relationships between utility fuel prices and crude oil prices reported by the U.S. Department of Energy, Energy Information Administration (EIA).1 These statistically estimated relationships are used to project potential future fuel prices based on EIA's published Annual Energy Outlook crude oil and natural gas price forecasts. So in short, the Alaska fuel price projections are based on EIA forecasts. We use the historic relationships between actual crude oil and actual community utility fuel prices to project each community's future fuel prices based on the EIA forecast. The fuel price projections are limited in their applicability to the modeling of project benefits and costs and should not be considered fuel price forecasts.
    - The rural regression model assumes that the price of diesel[2] to a particular utility receiving Power Cost Equalization assistance bears a stable linear relationship to the refiner acquisition cost of crude price.

[1] *Alaska Fuel Price Projections 2013 – 2035* Prepared for: Alaska Energy Authority. Prepared by: ISER, UAA. Fay, G., A. Melendez, S. Pathan, J. Armagost. June 30, 2013.
[2] PCE prices collected from PCE statistical reports.

- Finally, regressions and projections were also performed for larger communities in Alaska that are not part of the Power Cost Equalization program: Anchorage, Fairbanks, Juneau, Kenai, Ketchikan, Palmer, and Wasilla.
- In previous projections, we used the EIA published forecast for Imported Crude Oil Price. However, EIA no longer publishes these prices, and instead publishes prices for Brent Spot (a European terminal) and West Texas Intermediate. Because we are interested in the prices electric utilities are likely to pay and a significant amount of crude oil is still imported into the U.S., we use the simple average of the forecasted prices for both of these terminals in our projection.
- Carbon Pricing
  - Carbon Pricing grows at: 3%
  - Federal government estimates for the social cost of carbon (SCC) for use in federal B/C analyses are used here. These have been updated based on a May 2013 publication by the Interagency Working Group on Social Cost of Carbon[3].
    - Estimating the Social Cost of Carbon for Use in U.S. Federal Rulemakings: A Summary and Interpretation. NBER working paper, social cost of carbon; http://www.nber.org/papers/w16913
    - US Energy Information Administration, Voluntary Reporting of Greenhouse Gases Program. Table1. Carbon Dioxide Emission Factors for Stationary Combustion. http://www.eia.gov/oiaf/1605/coefficients.html#tbl1

Other Assumptions

- The "Cost of Scheduled Repairs" is assumed to increase at the same percentage for both the Proposed and Base Systems.
- Cost of O&M is assumed to increase at the same percentage for both the Proposed and Base Systems
- Fuel Prices (Wood & Heating Oil) are assumed to increase at the same percentage for both the Proposed and Base Systems.
- Base Fuel Price includes Carbon Pricing
- Heating Fuel Price = Base Fuel Price + Heating Fuel Premium
- NPV Discount rate is 3%

[3] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866. Interagency Working Group on Social Cost of Carbon, United States Government. May 2013. Available at: http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf

Carbon Pricing

Updated July 2013 (Dallin Jensen, ISER Summer Intern)

Carbon Prices

Source: National Bureau of Economic Research

"Estimating the Social Cost of Carbon for Use in the U.S. Federal Rulemakings: A summary and Interpretations"

http://www.nber.org/papers/w16913

Social cost of CO2 (Crude Oil) - Mid range projection:

Benchmark price is:	$36.00	2007$ per metric ton in 2013
Multiplier to 2012$ from 2007$	1.10732	
Convert to 2012$	39.86	
Ann % increase to Year 1 and beyond	3%	

CO2 Calculations

Source: US Energy Information Administration, Voluntary Reporting of Greenhouse Gases Program

Table1. Carbon Dioxide Emission Factors for Stationary Combustion

http://www.eia.gov/oiaf/1605/coefficients.html#tbl1

1 Metric Ton = 1000 Kg

Fuel	Emission Factor	Units	Metric Ton CO2/unit
Middle Distillate Fuels (No. 1, No. 2, No. 4 fuel oil, diesel, home heating oil)	10.15	Kg CO2/gallon	0.01015

Fuel Pricing

Updated September 2013 (Jeffrey Armagost and Alejandra Villalobos)

ISER - EIA 2013 AEO crude oil forecast

Energy Information Administration, Annual Energy Outlook 2013

EIA 50/50 Brent/ West Texas Intermediate Mid

CPI-U Multiplier (2011-2012)	1.0207

Gallons of Displaced Heating Fuel	2012$ Values	Heating Fuel Premium
<1,000	$1.61	$1.58
1,000 < 25,000	$1.07	$1.05
25,000 > 100,000	$0.54	$0.53
>100,000	$-	$-

Additional Model Assumptions
The "Cost of Scheduled Repairs" is assumed to increase at the same percentage for both the Proposed and Base Systems.
Cost of O&M is assumed to increase at the same percentage for both the Proposed and Base Systems
Fuel Prices (Wood & Heating Oil) are assumed to increase at the same percentage for both the Proposed and Base Systems.
Heating oil Price projection will follow the EIA long-term low estimate of Crude Oil for Urban communities.
Heating oil Price projection will follow the EIA long-term mid estimate of Crude Oil for Rural communities.
Heating oil Price projection will not follow the EIA long-term high estimate of Crude Oil for any communities.
Carbon Pricing grows at: 3%
Base Fuel Price (not including Carbon Pricing) in 2011$ after a four year period of steep decline grows at (per barrel): $0.05, $0.10, $0.15, $0.25, $0.30, $0.30 ...
Base Fuel Price (not including Carbon Pricing) is converted from 2011$ to 2012$ using 2.07%
Heating Fuel Premium grows at 2.07%
Base Fuel Price includes Carbon Pricing
Heating Fuel Price = Base Fuel Price + Heating Fuel Premium
NPV Discount rate is 3%

16 APPENDIX 2

ECONOMIC MODELING:

Breakdown of Wood Procurement Costs

Cost Item	$ per Cord	$ per Ton	User Overrides
Logging Cost - Direct			
Falling and Bucking (cutting)	$15.00	$12.00	
Skidding (wood-to-road)	$14.37	$11.70	
Sorting and Loading (grading)	$22.38	$17.90	
	$51.75	**$41.40**	
Logging Costs - Overhead			
General Burden	$0.00	$0.00	
Mobilization (travel)	$0.00	$0.00	
Camp (housing)	$0.00	$0.00	
	$5.00	**$4.00**	User Overrides
Transportation/Handling to Village			
	$4.75	**$3.80**	User Overrides
Development and Maintenance			
Temporary Roads	$0.00	$0.00	
Temporary Bulkhead (dock)	$0.00	$0.00	
Erosion Control	$1.00	$0.80	
Road Maintenance	$0.00	$0.00	
Slash Disposal (limbs)	$1.00	$0.80	
	$2.00	**$1.60**	User Overrides
Harvest cost	**$68.50**	**$50.80**	
Market Value (base price paid to owner)	**$17.50**	**$14.00**	
Total Wood Cost	**$81.00**	**$64.80**	

1 cord = 1.25 tons or ... 1 cord = 4' x 4' x 8' = 128 cf
1 cf = 0.0078125 cords

You must enter a value for each of these to override the "Logging Costs - Overhead". The entered values can be 0.

AEA General B/C Model

User changeable Fields

INPUTS

General Project Description	
Project Title	Port Graham Biomass Project
Project Description	
Renewable Energy Technology	Biomass
Client Name	Port Graham Tribal Council
Community	Port Graham

Heating Oil Input Overrides		
Nearest Fuel Community (Heating Oil)	Kenai	
2015 Base Fuel Price ($/gal)	$	5.98
2015 Heating Fuel Premium ($/gal)	$	1.14
Override Fuel Community Fuel Price?	Yes	
Override Includes Heating Fuel Premium?	Yes	
User Override Fuel Price - Heating Oil ($/gal)	$	5.98
Crude Oil Price Escalation ($/barrel)	EIA Low	
Use Fuel Price Escalation Factor?	Yes	
Override Fuel Price Escalation Factor?	No	
User Override Fuel Price Escalation Factor (%)		

Wood Inputs Overrides	
Year 1 Base Wood Price ($/ton)	
Second Base Wood Price ($/ton)	
Start Year Second Base Wood Price ($/ton)	

Proposed System Overrides		
Project Start (Year 1)		2015
Project Life (Years)		25
Displaced Heating Oil (gal/year)		5,365
Renewable Fuel Use (green tons/year)		125
Capital Costs ($)	$	210,634
Cost of Scheduled Repairs ($)	$	300
Cost of Scheduled Rapairs - Rate of Cost Increase (%)		1%
Operations & Maintenance (Year 1)	$	10,512
O&M - Years to First Cost Increase (years)		5
O&M - Rate of Cost Increase (%)		1%

Base System Overrides		
Cost of Scheduled Repairs ($)	$	400
Operations & Maintenance (Year 1)	$	1,000

Discount Rate (% increase/year)	3%

Specific Biomass Model for Port Graham

OUTPUTS

Annual Displaced Petroleum Fuel (gal/year)	5,365
Total Lifetime Displaced Petroleum Fuel (gal)	134,125
Annual Avoided CO2 (tonnes/year)	54.5
Total Lifetime Avoided CO2 (tonnes)	1,361.4

NPV Benefits	$	230,010
NPV Capital Costs	$	198,543
NPV Net Benefit	$	31,467

Net Profit (All dollars)	$	130,814
Funds to Community (All dollars)	$	38,381
Benefit / Cost Ratio (B/C)		1.16
Simple Payback (Avg annual savings)		15.4

Scenario 1: Single Wood Price, Life of the Project.	Price of Wood ($/green ton)			
	Current Model ($65)	$70	$75	$80
Net Profit	$ 130,814	$113,874	$ 97,586	$ 81,298
Funds to Community	$ 38,381	$ 41,461	$ 44,422	$ 47,384
B/C Ratio	1.16	1.10	1.05	0.99
Simple Payback (Avg annual savings)	15.4	16.2	17.1	18.0

Scenario 2: Blowdown Price for First 10 years.	Price of Wood ($/green ton)			
	$5 / $65	$5 / $70	$5 / $75	$5 / $80
Net Profit	$ 209,500	$199,801	$190,102	$180,403
Funds to Community	$ 24,074	$ 25,837	$ 27,601	$ 29,364
B/C Ratio	1.48	1.45	1.43	1.40
Simple Payback (Avg annual savings)	12.5	12.8	13.1	13.5

Annual Savings (Costs)

	Project Capital Cost	Total Savings (Costs)	Net Benefit
Units -->	$ per year	$ per year	$ per year
Year			
2014	$ -	$0	$0
2015	$ (210,634)	$14,571	($196,063)
2016	$ -	$13,063	$13,063
2017	$ -	$13,081	$13,081
2018	$ -	$13,115	$13,115
2019	$ -	$13,200	$13,200
2020	$ -	$13,205	$13,205
2021	$ -	$13,306	$13,306
2022	$ -	$13,311	$13,311
2023	$ -	$13,412	$13,412
2024	$ -	$13,416	$13,416
2025	$ -	$13,517	$13,517
2026	$ -	$13,520	$13,520
2027	$ -	$13,621	$13,621
2028	$ -	$13,623	$13,623
2029	$ -	$13,724	$13,724
2030	$ -	$13,725	$13,725
2031	$ -	$13,826	$13,826
2032	$ -	$13,826	$13,826
2033	$ -	$13,927	$13,927
2034	$ -	$13,927	$13,927
2035	$ -	$14,028	$14,028
2036	$ -	$14,026	$14,026
2037	$ -	$14,127	$14,127
2038	$ -	$14,124	$14,124
2039	$ -	$14,225	$14,225
2040	$ -	$0	$0
2041	$ -	$0	$0
2042	$ -	$0	$0
2043	$ -	$0	$0
2044	$ -	$0	$0
2045	$ -	$0	$0
2046	$ -	$0	$0
2047	$ -	$0	$0
2048	$ -	$0	$0
2049	$ -	$0	$0
2050	$ -	$0	$0
2051	$ -	$0	$0
2052	$ -	$0	$0
2053	$ -	$0	$0
2054	$ -	$0	$0
2055	$ -	$0	$0
2056	$ -	$0	$0
PV	($198,543)	$230,010	$31,467

Proposed Heating System Fuel Costs (Biomass)

	Renewable Heat	Renewable Heat Scheduled Repairs	Renewable Heat O&M	Renewable Fuel Use Quantity	Renewable Fuel Cost	Total Renewable Fuel Cost	**Proposed Heat Cost**
Units -->	displaced gal / yr	$ per year	$ per year	green tons	$ per unit	$ per year	**$ per year**
Year							
2014	-	$ -	$ -	0	$ -	$ -	**$ -**
2015	5,365	$ 300	$ 10,512	125	$ 64.80	$ 8,100	**$ 18,912**
2016	5,365	$ 303	$ 10,512	125	$ 64.80	$ 8,100	**$ 18,915**
2017	5,365	$ 306	$ 10,512	125	$ 64.85	$ 8,106	**$ 18,924**
2018	5,365	$ 309	$ 10,512	125	$ 64.94	$ 8,118	**$ 18,939**
2019	5,365	$ 312	$ 10,512	125	$ 65.18	$ 8,148	**$ 18,972**
2020	5,365	$ 315	$ 10,617	125	$ 65.47	$ 8,184	**$ 19,116**
2021	5,365	$ 318	$ 10,617	125	$ 65.76	$ 8,220	**$ 19,156**
2022	5,365	$ 322	$ 10,723	125	$ 66.05	$ 8,256	**$ 19,301**
2023	5,365	$ 325	$ 10,723	125	$ 66.34	$ 8,292	**$ 19,340**
2024	5,365	$ 328	$ 10,831	125	$ 66.62	$ 8,328	**$ 19,487**
2025	5,365	$ 331	$ 10,831	125	$ 66.91	$ 8,364	**$ 19,526**
2026	5,365	$ 335	$ 10,939	125	$ 67.20	$ 8,400	**$ 19,674**
2027	5,365	$ 338	$ 10,939	125	$ 67.49	$ 8,436	**$ 19,713**
2028	5,365	$ 341	$ 11,048	125	$ 67.78	$ 8,472	**$ 19,862**
2029	5,365	$ 345	$ 11,048	125	$ 68.06	$ 8,508	**$ 19,901**
2030	5,365	$ 348	$ 11,159	125	$ 68.35	$ 8,544	**$ 20,051**
2031	5,365	$ 352	$ 11,159	125	$ 68.64	$ 8,580	**$ 20,090**
2032	5,365	$ 355	$ 11,270	125	$ 68.93	$ 8,616	**$ 20,242**
2033	5,365	$ 359	$ 11,270	125	$ 69.22	$ 8,652	**$ 20,281**
2034	5,365	$ 362	$ 11,383	125	$ 69.50	$ 8,688	**$ 20,433**
2035	5,365	$ 366	$ 11,383	125	$ 69.79	$ 8,724	**$ 20,473**
2036	5,365	$ 370	$ 11,497	125	$ 70.08	$ 8,760	**$ 20,627**
2037	5,365	$ 373	$ 11,497	125	$ 70.37	$ 8,796	**$ 20,666**
2038	5,365	$ 377	$ 11,612	125	$ 70.66	$ 8,832	**$ 20,821**
2039	5,365	$ 381	$ 11,612	125	$ 70.94	$ 8,868	**$ 20,861**
2040	-	$ -	$ -	0	$ -	$ -	**$ -**
2041	-	$ -	$ -	0	$ -	$ -	**$ -**
2042	-	$ -	$ -	0	$ -	$ -	**$ -**
2043	-	$ -	$ -	0	$ -	$ -	**$ -**
2044	-	$ -	$ -	0	$ -	$ -	**$ -**
2045	-	$ -	$ -	0	$ -	$ -	**$ -**
2046	-	$ -	$ -	0	$ -	$ -	**$ -**
2047	-	$ -	$ -	0	$ -	$ -	**$ -**
2048	-	$ -	$ -	0	$ -	$ -	**$ -**
2049	-	$ -	$ -	0	$ -	$ -	**$ -**
2050	-	$ -	$ -	0	$ -	$ -	**$ -**
2051	-	$ -	$ -	0	$ -	$ -	**$ -**
2052	-	$ -	$ -	0	$ -	$ -	**$ -**
2053	-	$ -	$ -	0	$ -	$ -	**$ -**
2054	-	$ -	$ -	0	$ -	$ -	**$ -**
2055	-	$ -	$ -	0	$ -	$ -	**$ -**
2056	-	$ -	$ -	0	$ -	$ -	**$ -**
PV		**$5,643**	**$184,473**			**$141,869**	**$331,985**

Base Heating System Fuel Costs

	Fuel Use	Fuel Cost	Fuel Scheduled Repairs	Fuel O&M	Fuel Cost	**Base Heating Cost**
Units -->	Gal / year	$ per gal	$ per year	$ per year	$ per year	**$ per year**
Year						
2014	-	$ -	$ -	$ -	$ -	**$ -**
2015	5,365	$ 5.98	$ 400	$ 1,000	$ 32,083	**$ 33,483**
2016	5,365	$ 5.70	$ 404	$ 1,000	$ 30,574	**$ 31,978**
2017	5,365	$ 5.70	$ 408	$ 1,000	$ 30,597	**$ 32,005**
2018	5,365	$ 5.71	$ 412	$ 1,000	$ 30,642	**$ 32,054**
2019	5,365	$ 5.73	$ 416	$ 1,000	$ 30,756	**$ 32,172**
2020	5,365	$ 5.76	$ 420	$ 1,010	$ 30,891	**$ 32,322**
2021	5,365	$ 5.78	$ 425	$ 1,010	$ 31,027	**$ 32,462**
2022	5,365	$ 5.81	$ 429	$ 1,020	$ 31,163	**$ 32,612**
2023	5,365	$ 5.83	$ 433	$ 1,020	$ 31,299	**$ 32,752**
2024	5,365	$ 5.86	$ 437	$ 1,030	$ 31,435	**$ 32,903**
2025	5,365	$ 5.88	$ 442	$ 1,030	$ 31,571	**$ 33,043**
2026	5,365	$ 5.91	$ 446	$ 1,041	$ 31,707	**$ 33,194**
2027	5,365	$ 5.94	$ 451	$ 1,041	$ 31,843	**$ 33,334**
2028	5,365	$ 5.96	$ 455	$ 1,051	$ 31,979	**$ 33,485**
2029	5,365	$ 5.99	$ 460	$ 1,051	$ 32,114	**$ 33,625**
2030	5,365	$ 6.01	$ 464	$ 1,062	$ 32,250	**$ 33,776**
2031	5,365	$ 6.04	$ 469	$ 1,062	$ 32,386	**$ 33,917**
2032	5,365	$ 6.06	$ 474	$ 1,072	$ 32,522	**$ 34,068**
2033	5,365	$ 6.09	$ 478	$ 1,072	$ 32,658	**$ 34,209**
2034	5,365	$ 6.11	$ 483	$ 1,083	$ 32,794	**$ 34,360**
2035	5,365	$ 6.14	$ 488	$ 1,083	$ 32,930	**$ 34,501**
2036	5,365	$ 6.16	$ 493	$ 1,094	$ 33,066	**$ 34,652**
2037	5,365	$ 6.19	$ 498	$ 1,094	$ 33,201	**$ 34,793**
2038	5,365	$ 6.21	$ 503	$ 1,105	$ 33,337	**$ 34,945**
2039	5,365	$ 6.24	$ 508	$ 1,105	$ 33,473	**$ 35,086**
2040	-	$ -	$ -	$ -	$ -	**$ -**
2041	-	$ -	$ -	$ -	$ -	**$ -**
2042	-	$ -	$ -	$ -	$ -	**$ -**
2043	-	$ -	$ -	$ -	$ -	**$ -**
2044	-	$ -	$ -	$ -	$ -	**$ -**
2045	-	$ -	$ -	$ -	$ -	**$ -**
2046	-	$ -	$ -	$ -	$ -	**$ -**
2047	-	$ -	$ -	$ -	$ -	**$ -**
2048	-	$ -	$ -	$ -	$ -	**$ -**
2049	-	$ -	$ -	$ -	$ -	**$ -**
2050	-	$ -	$ -	$ -	$ -	**$ -**
2051	-	$ -	$ -	$ -	$ -	**$ -**
2052	-	$ -	$ -	$ -	$ -	**$ -**
2053	-	$ -	$ -	$ -	$ -	**$ -**
2054	-	$ -	$ -	$ -	$ -	**$ -**
2055	-	$ -	$ -	$ -	$ -	**$ -**
2056	-	$ -	$ -	$ -	$ -	**$ -**
PV			**$7,524**	**$17,549**	**$536,922**	**$561,995**

CPI multiplier 2011->2012
1.020694
Kenai Price Escalation Slope
0.782
Kenai Price Escalation Intercept
0.873

Social Cost of Carbon
Mid

Benchmark price is:
2007$ per metric ton in 2013
$36.00
Multiplier to 2012$
1.10732
Convert to 2012$
39.86
Increasing at
3%
Metric Tons CO2 per gallon:
0.01015

Crude	EIA 50/50 Brent/ West Texas Intermediate Low	EIA Low	
	2011$ per barrel	$2012 per barrel	$2012 per gal
2009	$ 82.06	$ 83.75	
2010	$ 81.19	$ 82.87	
2011	$ 103.06	$ 105.19	
2012	$ 100.50	$ 102.58	
2013	$ 92.31	$ 94.22	$ 3.03
2014	$ 80.35	$ 82.01	$ 2.82
2015	$ 74.85	$ 76.40	$ 2.72
2016	$ 70.83	$ 72.30	$ 2.66
2017	$ 67.50	$ 68.90	$ 2.61
2018	$ 67.55	$ 68.95	$ 2.63
2019	$ 67.65	$ 69.05	$ 2.64
2020	$ 67.90	$ 69.31	$ 2.66
2021	$ 68.20	$ 69.61	$ 2.68
2022	$ 68.50	$ 69.92	$ 2.70
2023	$ 68.80	$ 70.22	$ 2.72
2024	$ 69.10	$ 70.53	$ 2.75
2025	$ 69.40	$ 70.84	$ 2.77
2026	$ 69.70	$ 71.14	$ 2.79
2027	$ 70.00	$ 71.45	$ 2.82
2028	$ 70.30	$ 71.75	$ 2.84
2029	$ 70.60	$ 72.06	$ 2.86
2030	$ 70.90	$ 72.37	$ 2.89
2031	$ 71.20	$ 72.67	$ 2.91
2032	$ 71.50	$ 72.98	$ 2.94
2033	$ 71.80	$ 73.29	$ 2.97
2034	$ 72.10	$ 73.59	$ 3.00
2035	$ 72.40	$ 73.90	$ 3.02
2036	$ 72.70	$ 74.20	$ 3.05
2037	$ 73.00	$ 74.51	$ 3.08
2038	$ 73.30	$ 74.82	$ 3.11
2039	$ 73.60	$ 75.12	$ 3.14
2040	$ 73.90	$ 75.43	$ 3.18
2041	$ 74.20	$ 75.74	$ 3.21
2042	$ 74.50	$ 76.04	$ 3.24
2043	$ 74.80	$ 76.35	$ 3.28
2044	$ 75.10	$ 76.65	$ 3.31
2045	$ 75.40	$ 76.96	$ 3.35
2046	$ 75.70	$ 77.27	$ 3.38
2047	$ 76.00	$ 77.57	$ 3.42
2048	$ 76.30	$ 77.88	$ 3.46
2049	$ 76.60	$ 78.19	$ 3.50
2050	$ 76.90	$ 78.49	$ 3.54

2051	$	77.20	$	78.80	$	3.58
2052	$	77.50	$	79.10	$	3.63
2053	$	77.80	$	79.41	$	3.67
2054	$	78.10	$	79.72	$	3.72
2055	$	78.40	$	80.02	$	3.76
2056	$	78.70	$	80.33	$	3.81
2057	$	79.00	$	80.63	$	3.86
2058	$	79.30	$	80.94	$	3.91
2059	$	79.60	$	81.25	$	3.96
2060	$	79.90	$	81.55	$	4.01
2061	$	80.20	$	81.86	$	4.07
2062	$	80.50	$	82.17	$	4.12
2063	$	80.80	$	82.47	$	4.18
2064	$	81.10	$	82.78	$	4.24
2065	$	81.40	$	83.08	$	4.30
2066	$	81.70	$	83.39	$	4.36
2067	$	82.00	$	83.70	$	4.43
2068	$	82.30	$	84.00	$	4.49
2069	$	82.60	$	84.31	$	4.56
2070	$	82.90	$	84.62	$	4.63

Incremental Cost of Ultra Low Sulfur Diesel	Carbon price, Mid
$2012 per gallon diesel fuel	2012$ per gallon
$ -	
$ -	
$ -	
$ -	
$ -	$ 0.40
$ -	$ 0.42
$ -	$ 0.43
$ -	$ 0.44
$ -	$ 0.46
$ -	$ 0.47
$ -	$ 0.48
$ -	$ 0.50
$ -	$ 0.51
$ -	$ 0.53
$ -	$ 0.54
$ -	$ 0.56
$ -	$ 0.58
$ -	$ 0.59
$ -	$ 0.61
$ -	$ 0.63
$ -	$ 0.65
$ -	$ 0.67
$ -	$ 0.69
$ -	$ 0.71
$ -	$ 0.73
$ -	$ 0.75
$ -	$ 0.78
$ -	$ 0.80
$ -	$ 0.82
$ -	$ 0.85
$ -	$ 0.87
$ -	$ 0.90
$ -	$ 0.93
$ -	$ 0.95
$ -	$ 0.98
$ -	$ 1.01
$ -	$ 1.04
$ -	$ 1.07
$ -	$ 1.11
$ -	$ 1.14
$ -	$ 1.17
$ -	$ 1.21

real 2012$ per metric ton CO2-equivalent	CO2-equivalent allowance cost
	$2012 per gallon diesel fuel
2009	
2010	
2011	
2012	
2013	$ 39.86
2014	$ 41.06
2015	$ 42.29
2016	$ 43.56
2017	$ 44.87
2018	$ 46.21
2019	$ 47.60
2020	$ 49.03
2021	$ 50.50
2022	$ 52.01
2023	$ 53.57
2024	$ 55.18
2025	$ 56.84
2026	$ 58.54
2027	$ 60.30
2028	$ 62.11
2029	$ 63.97
2030	$ 65.89
2031	$ 67.86
2032	$ 69.90
2033	$ 72.00
2034	$ 74.16
2035	$ 76.38
2036	$ 78.67
2037	$ 81.03
2038	$ 83.47
2039	$ 85.97
2040	$ 88.55
2041	$ 91.20
2042	$ 93.94
2043	$ 96.76
2044	$ 99.66
2045	$ 102.65
2046	$ 105.73
2047	$ 108.90
2048	$ 112.17
2049	$ 115.54
2050	$ 119.00

$	-	$	1.24	**2051**	$	122.57
$	-	$	1.28	**2052**	$	126.25
$	-	$	1.32	**2053**	$	130.04
$	-	$	1.36	**2054**	$	133.94
$	-	$	1.40	**2055**	$	137.96
$	-	$	1.44	**2056**	$	142.09
$	-	$	1.49	**2057**	$	146.36
$	-	$	1.53	**2058**	$	150.75
$	-	$	1.58	**2059**	$	155.27
$	-	$	1.62	**2060**	$	159.93
$	-	$	1.67	**2061**	$	164.73
$	-	$	1.72	**2062**	$	169.67
$	-	$	1.77	**2063**	$	174.76
$	-	$	1.83	**2064**	$	180.00
$	-	$	1.88	**2065**	$	185.40
$	-	$	1.94	**2066**	$	190.96
$	-	$	2.00	**2067**	$	196.69
$	-	$	2.06	**2068**	$	202.59
$	-	$	2.12	**2069**	$	208.67
$	-	$	2.18	**2070**	$	214.93

17 APPENDIX 3

PORT GRAHAM CONSTRUCTION ESTIMATE:

PORT GRAHAM BIOMASS HEATING PLANT
CONSTRUCTION COST ESTIMATE

CATEGORY MAJOR	MINOR	REF	QTY	MATERIAL	LABOR	EQUIPMENT	TOTAL	LUMP SUM ADD	SUBTOTAL
SITEWORK									
	LOCATE AND MARK		16 HR		75	50	125		2,000
DIRECT BURIED HYDRONIC PIPING									
			1470 LF	4s			4s		66,150
	EXCAVATION		735 LF		2	6	8		5,880
	BEDDING/BACKFILL		735 LF	2.00	2	6	10.00		7,350
	VAULTS		7 EA	250	1200	3	1453		10,171
PUMPS AND VALVES									
	PUMPS, VALVES, PIPES		4 EA	1000	500		1500		6,000
	PRESURE TANK/AIR SEPERATOR/CHEMICAL FEEDER		1 EA	1000	250		1250		1,250
	HEAT EXCHANGERS		6 EA	1800	500		2300		13,800
BOILER PACKAGE									
	INCLUDES DELIVERY		1	45000	500	500	46000		46,000
	STACK		15 LF	250	50		300		4,500
POWER									
	SERVICE		1 LS	500	1500		2000		2,000
	BREAKER PANEL		1 LS	500	1000		1500		1,500
	METER BASE		1 LS	500	200		700		700
	BRANCH WIRING		1 LS	1000	1500		2500		2,500
CONTROLS									
			1 LS	500	1500		2000		2,000
START UP/WATER TESTING									
SUPPORT/TRAINING			20 HR		75		75		1,500
SUB-TOTAL									
SUB-TOTAL									
			18.00%						
TOTAL									
				$210,634					
		O&P		$32,131					
				$178,503					
		$		$20,796	CONTINGENCY @ 12%				
				$173,301					

TOTAL BUILDING EXPANSION **$ 18,467.56**

BOILER BUILDING									
EXCAVATE	12 CY	10	0.54	25	26.6	4	14		168
BACKFILL	4 CY	38	1.06	16	54.17	1.17	26.6		106
STEM WALL	28 LF	38	0.17	16	19.23	0.29	8.44		1,517
SLAB	48 SF	13.5	0.29	4.4	8.44		6.2		420
WALLS	440 SF	4.04		3.2	6.2		9.2		3,714
ROOF	48 SF	3.2		3	6.2		9.2		298
	440 SF	17		6.58	26.58		26.58	550	12,245

18 APPENDIX 4

PORT GRAHAM GARN BOILER HARVEST PLAN

Port Graham GARN boiler harvest plan

December 2013

Nathan Lojewski, CF

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1

I. Introduction

The Port Graham GARN boiler biomass project will provide Port Graham with heat distributed along a community heat loop for 7 buildings. A GARN boiler will be used to burn biomass (i.e. wood) to heat the liquid pumped through the heat loop. The GARN boiler is projected to require approximately 100 cords of fuel wood per year to meet the heat load of the system. The Port Graham vicinity has abundant forest resources, a developed forest road system, and is an ideal location for biomass energy projects.

This harvest plan has been developed to provide a guide to fueling the Port Graham GARN boiler biomass project for the first 5 years of operation. The plan outlines the location, ownership, and approximate harvest volume of forest biomass for use by the Port Graham GARN boiler biomass project. It will also recommend harvest systems that are feasible for the project and the community. In addition, permits and environment information required for biomass harvest will be discussed.

II. Land

a. Land Ownership

Forested land in the Port Graham area with harvestable biomass is primarily located on Native allotments, Port Graham Corporation, or English Bay Corporation lands (Figure 1). In addition, approximately 280 acres owned by Port Graham Village Council directly adjacent to Port Graham may be used for some biomass harvesting. Since there are abundant resources, only forests accessible from the existing road system are considered.

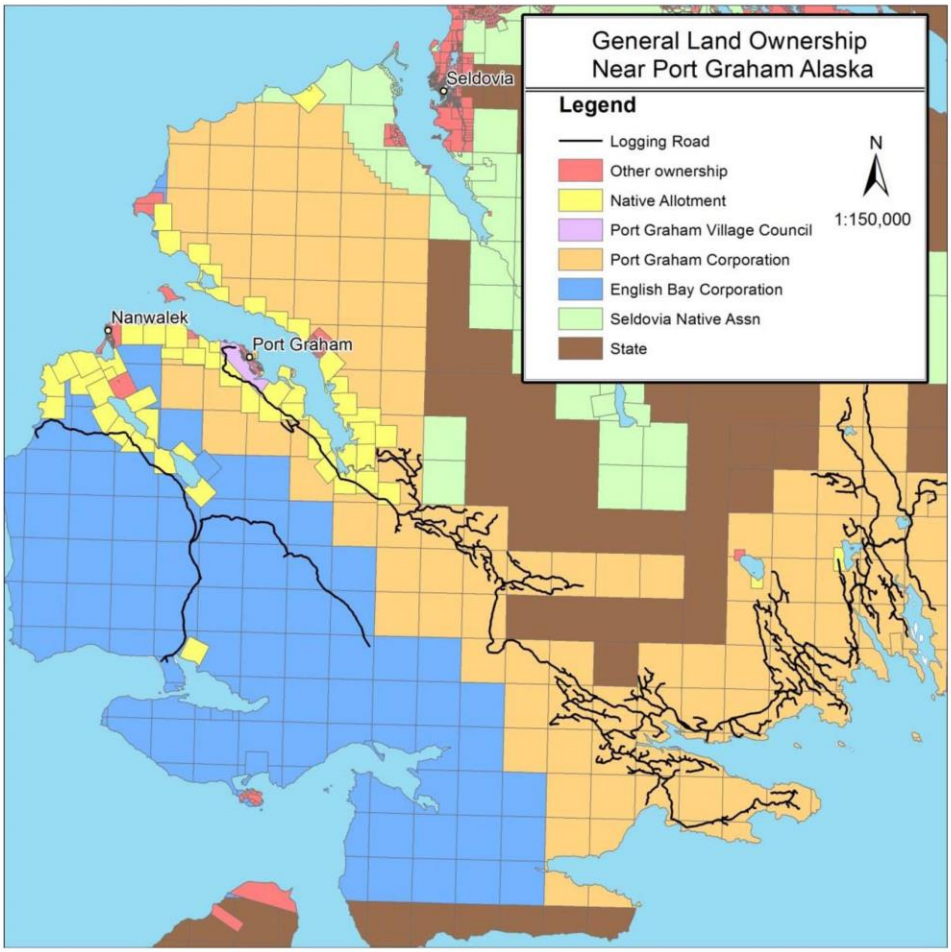


Figure 1. General land ownership near Port Graham Alaska

Table 1. Road accessible land near Port Graham and timber volume

Land Owner	Acres	Standing Volume (cords)	Sustainable Harvest Level (cords/year)
Native Allotment	1,339	80,538	807
Port Graham Corporation	20,161	211,082	7,799
Grand Total:	**21,501**	**291,620**	**8,606**

b. Harvest location and timing

In addition to standing timber, the Port Graham area has a considerable resource in windthow located in close proximity to the biomass project. Biomass harvesting for the first five years of operation should come from existing blown down trees in the area. There are currently 78 acres of blown down trees which are accessible from the logging road leaving Port Graham (December 2013). Initial harvesting should focus on the 42 acres of blown down trees located near mile 6.5 on the logging road on Native allotment AKAA 007196 and the adjacent Port Graham Corporation ownership. Blow down in the area is a bark beetle hazard for the surrounding forest and removal of blown down trees will not only supply fuel for the GARN boiler but help meet forest health management objectives. Should negotiating with property owners not be successful, there is a plentiful resource elsewhere. A secondary area to be considered is other blown down trees on the edges of Port Graham Corporation clear cuts throughout the area. A third option is mature standing forests on Native allotments that are road accessible (eleven allotments averaging 160 acres each). And finally, there is another 36 acres of blown down on English Bay Corporation land located near mile 15 and 16 of the logging road. In addition to existing resources, the new airport is in the design phase, and as part of the project, an estimated 157 acres will be cleared of trees; the Environmental Assessment indicates the cleared timber will be available to the community.

There is a more than adequate wood supply in the blowdown on Native allotment AKAA 007196 and the adjacent Port Graham Corporation land to fuel the project for the next 5 years (Table 2). Figure 2 shows the location and access to 6 harvest units on Native allotment AKAA 007196 and Port Graham Corporation land. Each unit is approximately 2-3 acres in size.

c. Harvest Volume

The annual fuel requirement for the Port Graham GARN boiler project is estimated to be 100 cords or 125 bone dry tons per year. Table 2 shows the existing volume of blown down timber in harvest units based on Chugachmiut forest inventory data. It is recommended to initially harvest more than 100 cords per year; all volume of blowdown may not be salvageable.

Table 2. Harvest volume per harvest unit

Harvest Unit	Timber Volume (cords)
Year 1	150
Year 2	150
Year 3	136
Year 4	99
Year 5	100
Reserve/Year 6	163
Total	799

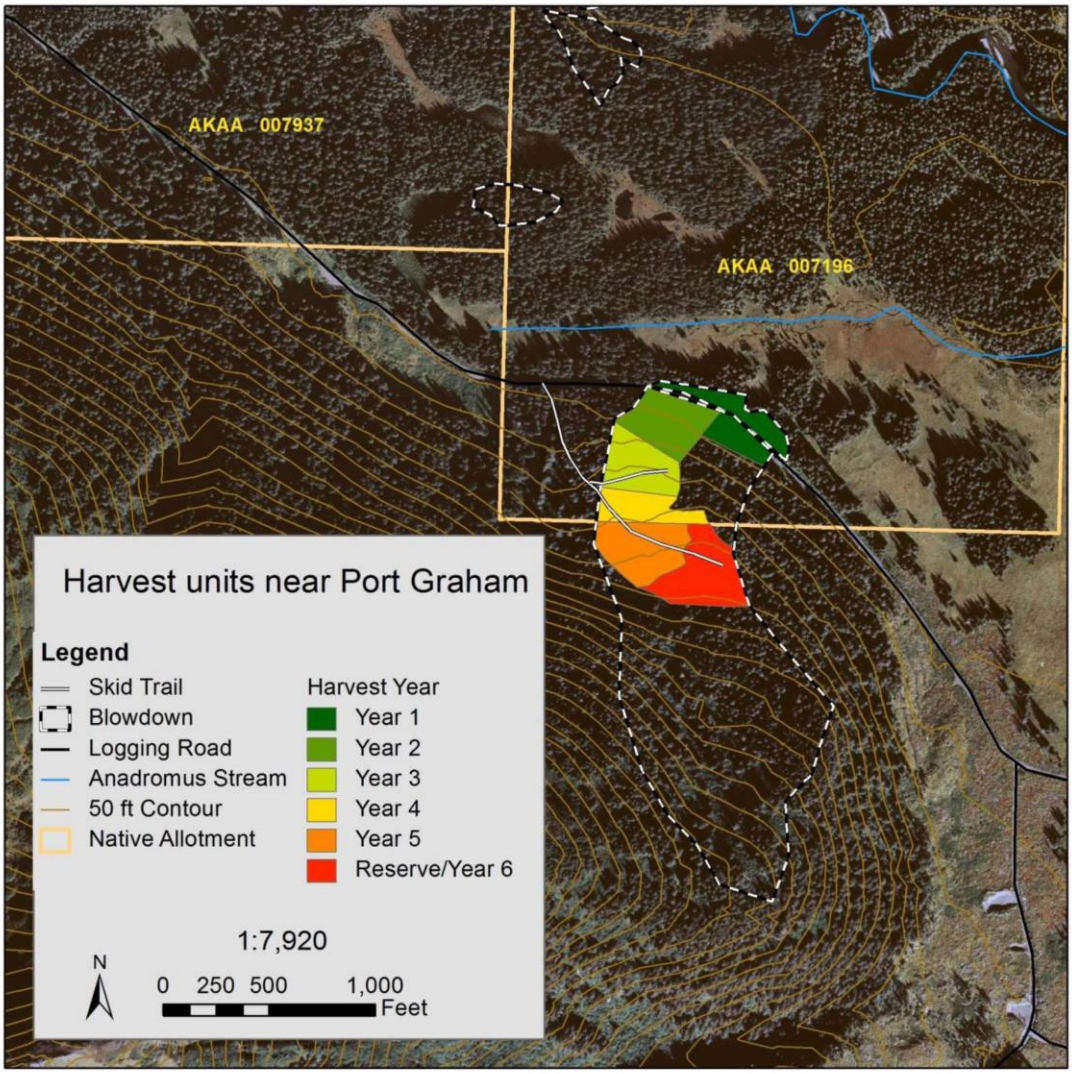


Figure 2. Harvest units for Port Graham GARN boiler project

III. Harvest System

The harvest system is the method in which fuel wood will be removed from the forest. Harvest systems can be categorized into five basic types; animal, tractor or skidder, shovel, cable, and balloon or helicopter. The size and scope of this harvest plan, the relatively low value of the forest product, and the available resources in Port Graham immediately limit the harvest system to a small ground based system. In addition to the harvest system, log hauling from the forest to the GARN boiler must be considered. Additional equipment will be required for log hauling (either existing or new).

a. Equipment

For the harvest system, a small cable skidder with manual fellers is recommended. Other systems - a shovel system or a cable system – are better suited to the terrain but have a high capital cost that cannot be justified for a 100 cord/year harvest requirement. Table 3 illustrates the capital cost of equipment required for the various harvest systems and log hauling[1], including a small cable skidder with a small feller buncher. The feller buncher system would be more productive and safer for employees, but the capital cost may provide to be prohibitive to the project.

Aa small self-loading log trailer for the fuel hauling system is also recommended. This trailer can be towed by existing vehicles in Port Graham. It will be used to bring logs from the woods to the log storage area and from the storage are to the GARN boiler site in winter. One limitation of the self-loading trailer is that during winter months the steep grade between the log storage facility and the GARN boiler building may require using alternative means to pull the trailer. There are many existing options in the community for this eventuality - the Port Graham Corporation's small bulldozer, Port Graham Village Council's road grader, or a skidder could be used to haul the trailer when road conditions are too icy for regular vehicles.

Table 3. Estimated cost of harvest and hauling equipment[1]

Equipment type	Description	Used	New
*Small Cable Skidder	John Deer 440, 540, or equivalent	$25,000-$50,000	
Feller Buncher	Used Rubber Tire Feller Buncher	$35,000-$75,000	
*Chain Saw (2 minimum)	Stihl 460 Chain Saw		$1,200
Log Truck	Standard self-loader trailer with tractor	$22,000-$150,000	
Log Truck	6x6 army surplus flatbed with self-loader	0-$10,000	
*Log Trailer	Hakmet, Nokka, or similar		$20,000-$40,000
*Small log splitter	20+ ton unit capable of splitting 4ft lengths		$1,500 - $5,000

* minimum recommended equipment

b. Log Storage

The old log sort yard located approximately 1 mile from Port Graham will be used to season and store fuel wood. The sort yard is approximately 6.5 acres in size and is owned by the Port Graham Village Council.

In order to obtain efficient combustion in the GARN boiler fuel wood must be seasoned prior to burning. It will likely take 12 months in the humid Port Graham climate to sufficiently season wood (i.e. 20% moisture content). Wood being seasoned must be kept out of the rain. An open sided pole barn is the best option d

[1] Data aggregated from the December 2013 edition of the Lumberman's Equipment Digest print edition; can be accessed from www.lumbermenonline.com

to house seasoning wood but capital cost should be taken into account. Logs need to be stacked off the ground. This can be accomplished by constructing the first row of logs perpendicular to a small number of logs on the base layer, than covered with waxed "kraft" paper. This paper is routinely used by hazard fuels reduction crews to cover slash piles while seasoning before burning. Logs will need to be split and bucked before burning in the GARN boiler. This could occur at the sort yard or at a smaller storage/staging area directly adjacent to the boiler building.

IV. Permitting and Regulations

Permitting requirements can be split into two general categories, fee simple lands (as Port Graham Corporation or Port Graham Village Council lands) and trust lands (Native allotments). Before harvesting on any land the land owner should be consulted and a timber sale agreement or land access agreement must be obtained. Fee simple lands fall under state regulations while Native allotment trust land falls under federal regulations. For both fee simple land and trust lands permitting and consultation with the Alaska Department of Fish and Game is required when operations are near or cross anadromous waters. In general, AK Fish and Game should be consulted whenever stream crossing occur.

a. Fee Simple lands

Permitting requirements for fee simple lands are generally simple and straight forward. The Alaska Forest Practices Act is the primary authority granted to the State of Alaska for regulation of timber harvesting. Contacting the Kenai Kodiak area forestry office in Soldotna, AK should be done prior to initiating any timber harvesting. The Kenai Kodiak area forestry office phone number is (907)-260-4200 and while learning the process initial contact should be made months prior to harvesting timber.

b. Trust lands

Permitting and regulations on trust lands (Native allotments) can be much more cumbersome and time consuming than fee simple lands. All permitting and land access agreements are reviewed by Chugachmiut's Forestry program. Chugachmiut's forestry program can be reached by phone via (907)-562-4155. All trust lands, because of their federal trust status, are subject to the National Environmental Policy Act. Lands containing blowndown timber such as the allotment identified for harvesting in this plan may fall under a categorical exclusion for emergency forest health actions:

"The Departmental Manual (516 DM 2.3A(3) and 516 DM 2, Appendix 2) requires that before any action described in the following list of CXs is used, the list of "extraordinary circumstances" must be reviewed for applicability. If a CX does not pass the "extraordinary circumstances" test, the proposed action analysis defaults to either an EA or an EIS. When no "extraordinary circumstances" apply, the following activities do not require the preparation of an EA or EIS. In addition, see 516 DM 2, Appendix 1 for a list of DOI-wide categorical exclusions. As proposed actions are designed and then reviewed against the CX list, proposed actions or activities must be, at a minimum, consistent with the DOI and the BLM regulations, manuals, handbooks, policies, and applicable land use plans regarding design features, best management practices, terms and conditions, conditions of approval, and stipulations."

The Departmental Manual (516 DM 2.3A(3) and 516 DM 2, Appendix 2….

"C. Forestry. Part 8 (8) Salvaging dead or dying trees not to exceed 250 acres, requiring no more than 0.5 mile of temporary road construction. Such activities:

(a) May include incidental removal of live or dead trees for landings, skid trails, and road clearing.

(b) May include temporary roads which are defined as roads authorized by contract, permit, lease, other written authorization, or emergency operation not intended to be part of the BLM transportation system and not necessary for long-term resource management. Temporary roads shall be designed to standards appropriate for the intended uses, considering safety, cost of transportation, and impacts on land and resources; and

(c) Shall require the treatment of temporary roads constructed or used so as to permit the reestablishment, by artificial or natural means, of vegetative cover on the roadway and areas where the vegetative cover was disturbed by the construction or use of the road, as necessary to minimize erosion from the disturbed area. Such treatment shall be designed to reestablish vegetative cover as soon as practicable, but at least within 10 years after the termination of the contract.

(d) For this CX, a dying tree is defined as a standing tree that has been severely damaged by forces such as fire, wind, ice, insects, or disease, and that in the judgment of an experienced forest professional or someone technically trained for the work, is likely to die within a few years. Examples include, but are not limited to:

(i) Harvesting a portion of a stand damaged by a wind or ice event.

(ii) Harvesting fire damaged trees."

Regardless of whether this project would fall under a NEPA categorical exclusion or not, the sale or salvage of timber will be required to comply with the Bureau of Indian Affairs Timber Sales regulations outline in the Indian Affairs manual.

APPENDIX 5

MISCELLANEOUS DOCUMENTS

JOB DESCRIPTION

Job Title: Office Building & General Maintenance
Department:
Reports To: Tribal Administrator
FLSA Status: Nonexempt (hourly)

Summary:
This position is responsible building maintenance of all buildings owned by PGVC. Snow removal at council parking, entrances, porches, roof and balconey.

Essential Duties and Responsibilities include the following . Other duties may be assigned as needed.

- Snow removal from all entrances, ramps, parking, for all buildings owned by PGVC.
- Snow removal from all roofs as needed.
- Sand entrances to council building and clinic as needed
- Maintenance on vehicles including cleaning the snow off them.
- Keep track of fuel tanks and transfer fuel from outside to inside.
- Keep shop cleaned and organized.
- Keep fire hall garage clean and maintained.
- Keep track of all fuel levels for pgvc buildings.
- Keep furnace maintained and office vents/heaters bled and in working order.
- Any other maintenance needed on any of the buildings as needed and any other duties that require maintenance.

Qualifications:
To perform this job successfully, an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge, skill and/or ability required. Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions.

Knowledge And Abilities

- Able to work effectively with office staff.
- Able to effectively handle potentially stressful situations in a calm and professional manner
- Responsible, reliable and trustworthy.
- Experience with Furnaces
- Experience with vehicle maintenance

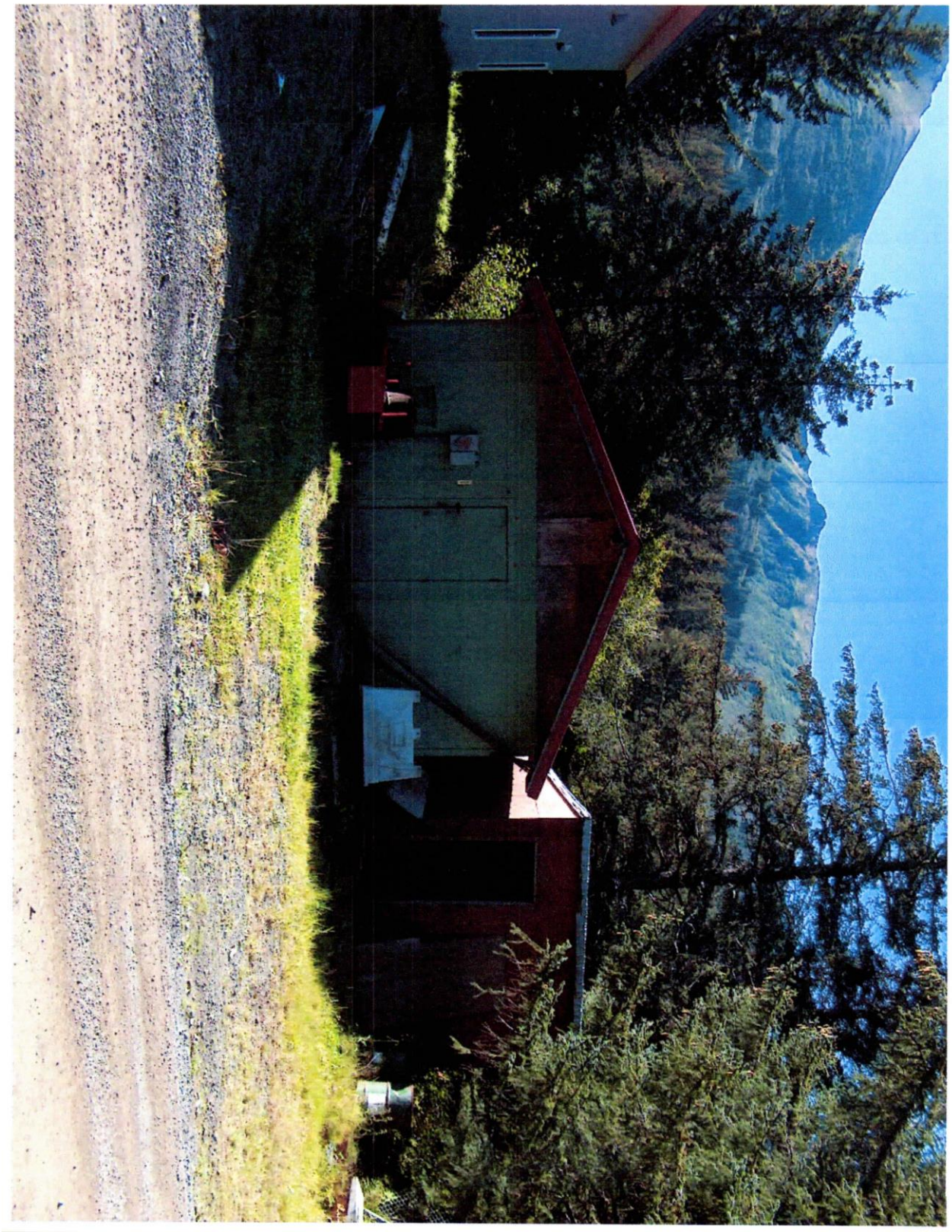
Certificates
Current Drivers License

Physical Demands:
The employee is regularly required to to talk, including the ability to pass information via the telephone and verbally communicate with staff and other employees and to perform his or her duties in a safe manner, including driving. The ability to walk, lift up to 50 lbs or less, bend, push, pull and stand is needed to perform al requirements of this position.

Work Environment:
The work environment characteristics described here are representative of those an employee encounters while performing the essential functions of this job

Hours of work are between Monday and Friday 8:30 am to 5:00 pm. A minimum of 20 hrs per week and be as needed for emergencies or weather conditions. Port Graham Village Council maintains a drug and alcohol free and non- smoking environment.

Native Preference under P.L. 93-638

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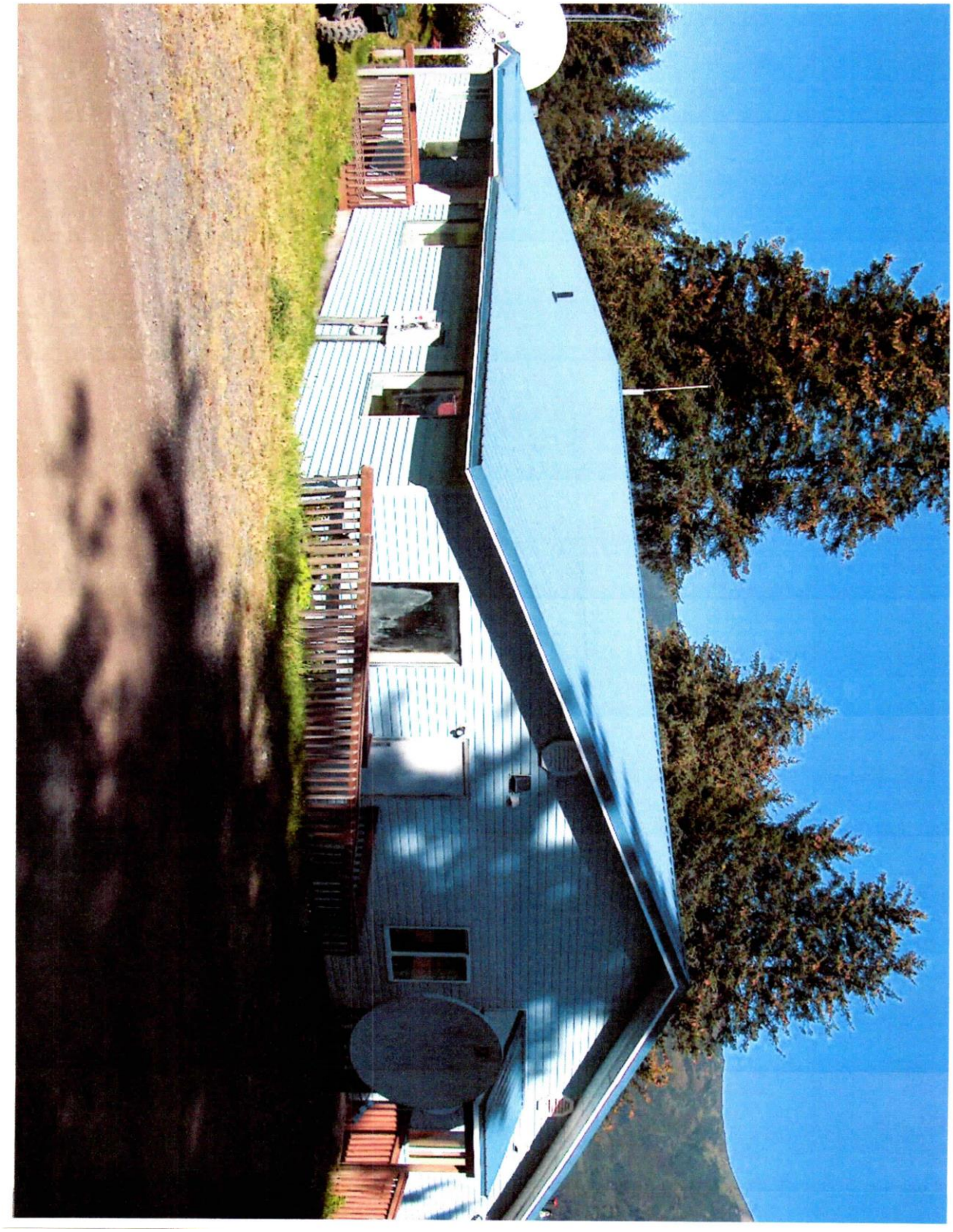

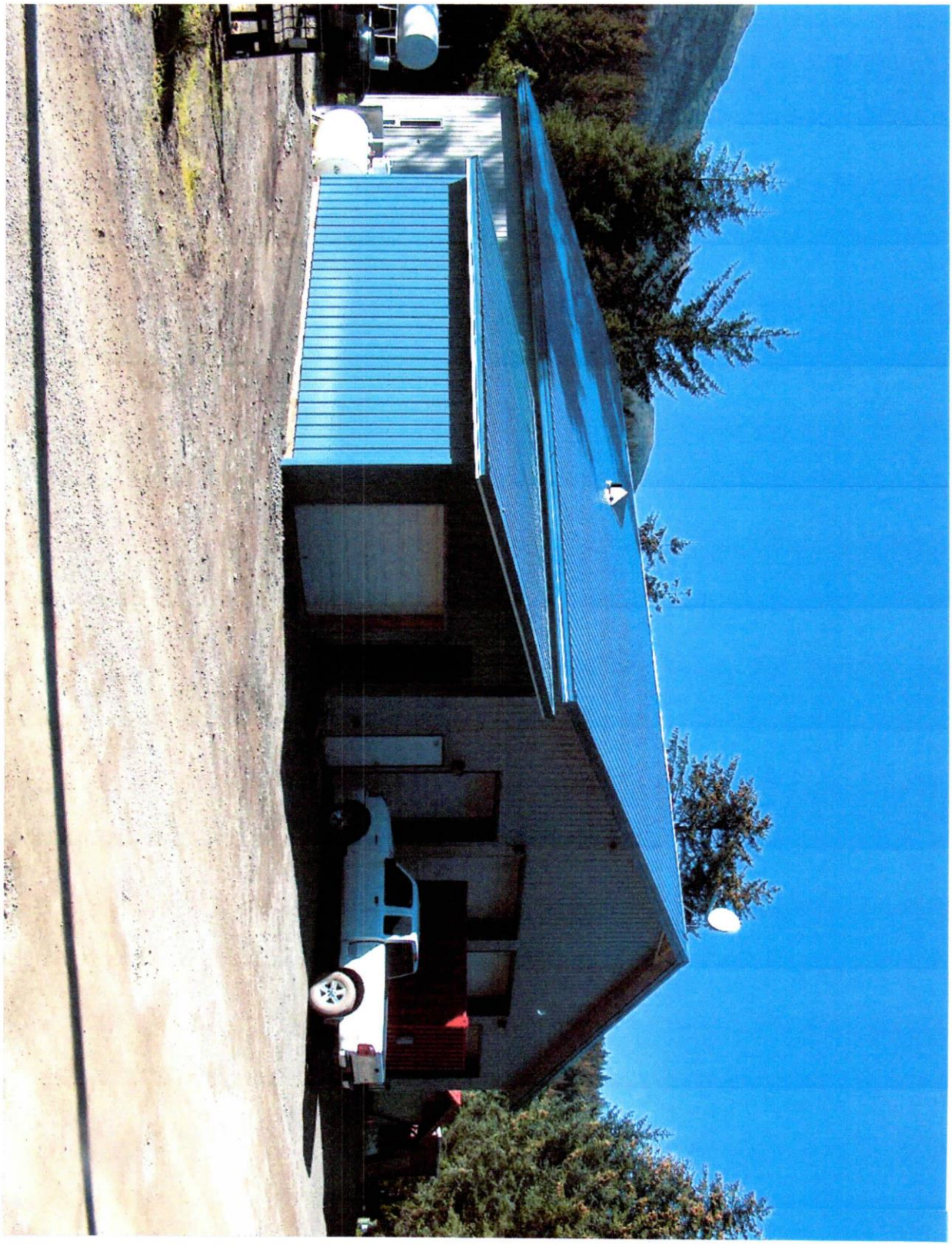

19 APPENDIX 5

[ ] 2760 Sherwood Lane, Ste 1-A
Juneau, Alaska 99801
Phone (907) 465-4331
Fax (907) 465-5521

[ ] 5700 E. Tudor Road
Anchorage, Alaska 99507
Phone (907) 269-2004
Fax (907) 269-0098

[ ] 1979 Peger Road
Fairbanks, Alaska 99709
Phone (907) 451-5200
Fax (907) 451-5218

APPLICATION FOR FIRE AND LIFE SAFETY PLAN REVIEW
Authority: 13 AAC 50.027

1. Name of building (previous and new): _____

_____

2. Provide a project description and *previous review number* (if applicable) of the work: _____

_____

3. Type of Project and cost: [ ] new building [ ] addition to an existing building [ ] renovations [ ] occupancy change

[ ] foundation [ ] exterior wall envelope (framing) [ ] fuel system project [ ] relocation [ ] fire system project

Project Cost $ _____ **(Required for Fuel Systems and Renovations/Remodels (labor and materials))**

4. Describe use of the building: _____

Lot Number: _____ **Block Number:** _____ **Subdivision Name:** _____

Physical Address (required): # _____ **Street** _____ **Suffix** _____ **City** _____ **Zip** _____

Type of construction: _____ **(I, II, III, IV, V)** **Indicate use or IBC occupancy:** _____ **(A,B,E,F,S,I,H,R,U)**

Total square footage: _____

Suppression system to be installed: [ ] YES [ ] NO - # Devices: _____
Fire Alarm system to be installed: [ ] YES [ ] NO - # Devices: _____

APPLICANT NAME: _____	OWNER NAME: _____
COMPANY NAME: _____	BUSINESS NAME: _____
MAILING ADDRESS: _____	MAILING ADDRESS: _____
CITY: _____	CITY: _____
ZIP: _____ STATE: _____	ZIP: _____ STATE: _____
PHONE: _____ FAX: _____	PHONE: _____ FAX: _____
EMAIL: _____	EMAIL: _____

I certify that I have read and examined this application and know the same to be true and correct. I recognize that approval of plans submitted does not presume to give approval to oversights by the Division of Fire and Life Safety nor grant authority to violate or cancel the provisions of any other state or local law regulating this occupancy. 13AAC 50.027(c)(5): "If any work for which a plan review and approval is required by this subsection has been started without first obtaining plan review and approval, a special processing plan review fee will be charged."

_____ _____
APPLICANT SIGNATURE *DATE*

Please Submit Applicable Documents – stamped by an Alaskan Registered Design Professional

[ ] SCALED PLOT PLAN: Show distance to property lines and existing buildings.
[ ] STRUCTURAL DRAWINGS - including: design criteria, connections.
[ ] ARCHITECTURAL DRAWINGS - including: Interior and exterior wall details, means of egress, fire extinguisher information.
[ ] MECHANICAL DRAWINGS - including: Hood and duct, fuel tank size and location.
[ ] ELECTRICAL DRAWINGS - including: Emergency lighting, exit signs.
[ ] FIRE PROTECTION SYSTEM: Automatic sprinklers, hood suppression, fire alarm.
[ ] FIRE DEPARTMENT ACCESS LETTER – including: access and fire flow approval and notification

IT IS IN VIOLATION OF STATE LAW TO BEGIN ANY CONSTRUCTION BEFORE A PERMIT HAS BEEN ISSUED BY THIS OFFICE.

AS 18.70.010 – AS 18.70.100 www.akburny.com **Rev (10/13)**

20 REFERENCES

Environmental Assessment, Nanwalek and Port Graham Airport Project, Nanwalek and Port graham, Alaska, prepared by Dowl HKM, August 2013

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Cost Analysis of Forest Biomass Supply Chain Logistics, Dalia Abbas, Robert Handler, Dennis Dykstra, Bruce Hartsough, and Pasi Lautala, July 2013, Journal of Forestry

Preliminary Best Interest Finding (Revised) for a Long Term Timber Sale for Biomass Utilization in Tok, AK, State of Alaska, Department of Natural Resources, December 2012.

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Port Graham Biomass Resource Assessment

Nathan Lojewski CF; Forestry Manager
Chugachmiut Forestry
Anchorage, Alaska

December 17, 2013

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Executive Summary

The purpose of this resource assessment is to determine the maximum sustainable harvest of biomass fuel, or maximum Annual Allowable Cut (AAC) from the Port Graham vicinity across all ownerships. This assessment is not focused on a specific biomass project, although it will address fuel requirements for the proposed GARN boiler project. Initial design work has indicated that the proposed GARN boiler project will require roughly 100 bone dry tons (BDT) of fuel annually. The assessment is meant to guide the sizing of sustainable bioenergy projects in Port Graham.

The Port Graham area contains 25,103 acres of land accessible for timber harvesting but because of environmental and administrative constraints only 16,786 acres are included in this resource assessment. The maximum sustainable harvest level or Annual Allowable Cut (AAC) for the Port Graham area is 13,135 BDT, but this level of harvest may not be sustainable when considering social constraints. There are a number of factors than can influence AAC wither upwards or downwards such as varying landowner participation, natural disasters, current accessible mature timber, forest growth rates, higher value forest products (historically 40% of timber volume), and others. With these factors in mind; it is recommended that a more conservative AAC range of 3,259 and 6,578 BDT/year be used. Other events in the future have the potential to greatly increase the AAC including repair of the road to Seldovia and construction of the road to Nanwalek. If these two roads and land previously reserved form harvest are considered the timber base for the area would increase by nearly 20,000 acres greatly increasing the AAC.

It is important to realize that forests are in an ever changing state of regeneration, growth, decline, and mortality or “disturbance”. The data used in this assessment represents only a snapshot in time, current as of the writing of this assessment. As forests continue through the cycle of regeneration, growth, decline, and mortality; this assessment will need to be periodically updated as it will no longer represent the current state of timber resources in the Port Graham vicinity. Natural disturbances such as spruce bark beetle outbreak and windthrow could remove mature timber, while man made actions such as road building could provide access to timber resource currently un-reachable.

Introduction

The purpose of this biomass resource assessment is to determine the maximum sustainable harvest of biomass fuel, or maximum Annual Allowable Cut (AAC) from the Port Graham vicinity across all ownerships. This assessment is not focused on a specific biomass project, although it will address fuel requirements for the proposed GARN boiler project. Initial design work has indicated that the proposed GARN boiler project will require roughly 100 bone dry tons (BDT) annually. The assessment is meant to guide the sizing of sustainable bioenergy projects in Port Graham. Timber resources are abundant and plentiful in the Port Graham vicinity and when managed properly can sustainably supply forest resources such as saw timber, biomass fuel, and fire wood. The Port Graham vicinity contains 25,103 acres of accessible land of which 16,786 acres have been vegetation typed (figure 1). The remaining 8,317 acres were not included in this assessment.

It is important to realize that forests are in an ever changing state of regeneration, growth, decline, and mortality or "disturbance". The data used in this assessment represents only a snapshot in time, current as of the writing of this assessment. As forests continue through the cycle of regeneration, growth, decline, and mortality; this assessment will need to be periodically updated as it will no longer represent the current state of timber resources in the Port Graham vicinity. Natural disturbances such as spruce bark beetle outbreak and windthrow could remove mature timber, while man made actions such as road building could provide access to timber resource currently un-reachable.

Analysis and Discussion[1]

Annual Allowable Cut (AAC)

When considering all available timberland in the Port Graham vicinity, the maximum annual allowable cut (AAC) for the area is 13,135 BDT (Table 1.) however this is likely overestimating the sustainable AAC. A recommended range of AAC will be presented in the following sections. The majority of the timber resource is accessible from the existing road system (10,758 BDT/year) and 99% of the resource is owned by Native corporations or located on privately held Native Allotments; Port Graham Corporation is the largest landowner in the Port Graham vicinity although neighboring English Bay Corporation and Seldovia Native Association also own large tracts of commercial timber land.

Potential factors causing a decrease of the maximum AAC

The calculation of the AAC for this assessment is based on a four key assumption (see AAC in methods), if any one of these assumptions is violated the AAC may be higher or lower than calculated. The following section discusses factors which could affect the assumptions made during the calculation of the AAC. The factors listed here would cause a decrease in the maximum AAC.

[1] A detailed description of the methods used in this assessment are included in the "Methods" section at the end of the assessment

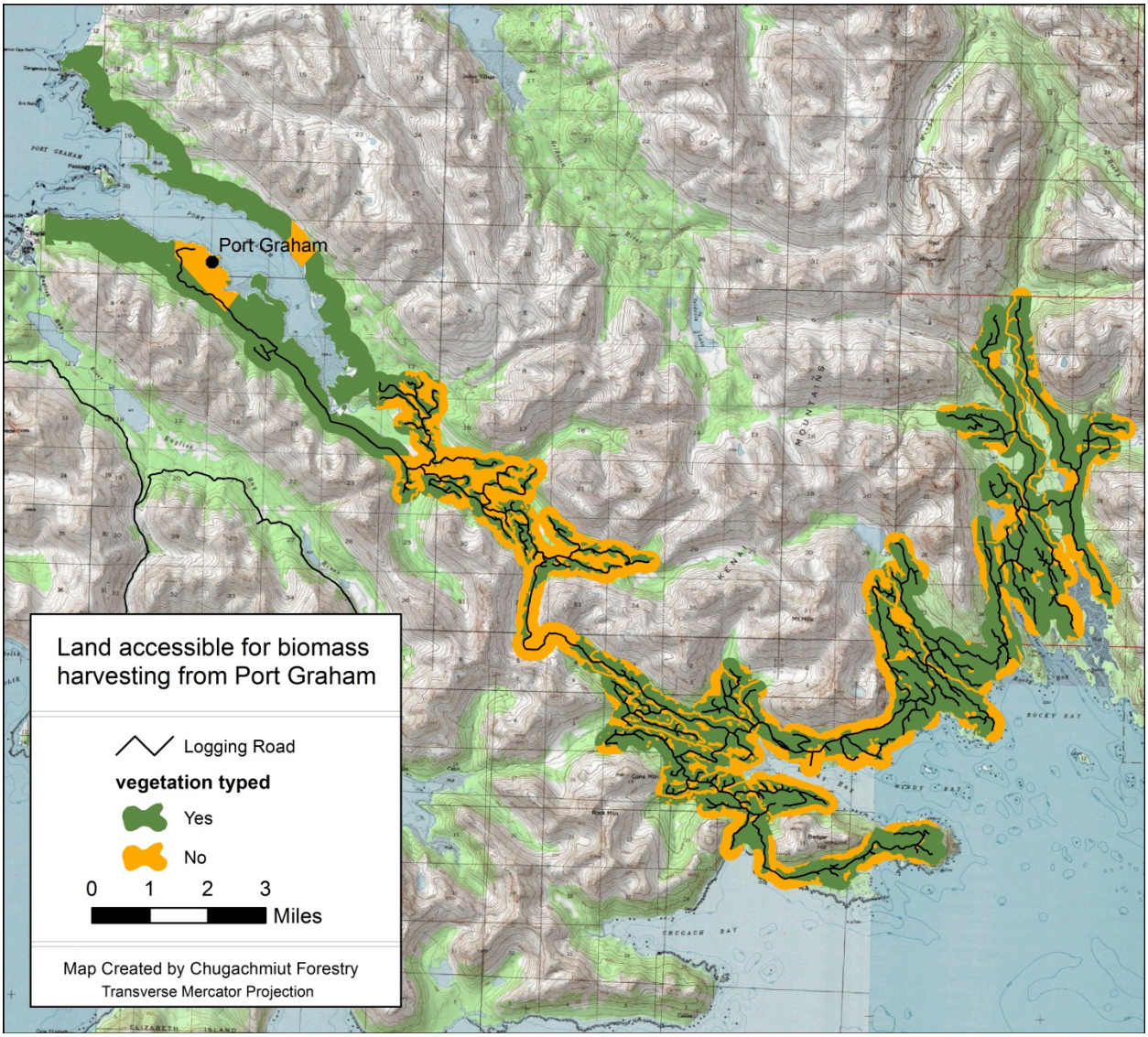

Figure 1 Land accessible for biomass harvesting from Port Graham.

Not all forest stands are mature.

In the Port Graham vicinity roughly 9,623 acres of timberland are immature forest while only 7,163 acres are mature. All but 9,623 acres of the immature forest have been previously harvested beginning in the 1960's and account for over half of the total AAC (Table 2.). A 100 year rotation age was assumed for a forest stand to reach full maturity and standing volume. As can be seen in Table 2, the oldest stands were regenerated after harvesting which began in the 1960's. The oldest of these stands will not reach maturity for 50 more years. As a result, during the first 50 years of biomass extraction, nearly all of the cut will need to come from the existing mature forests. The mature forests currently have a standing volume of 534,650 BDT and can provide up to 10,693 BDT/year before being totally depleted, less than the maximum AAC of 13,135 BDT/year .

Table 1. Available biomass resource, ownership, and access type in the Port Graham vicinity

Land Owner	Access Type	Acres	Standing Volume (BDT)	AAC (BDT)
Native Allotment	Road:	1,339	302,467	1,009
	Water:	2,569	199,375	1,994
	Construction:	32	2,420	24
	Total:	**3,941**	**302,467**	**3,027**
Port Graham Corporation	Road:	20,161	263,853	9,749
	Water:	386	26,212	262
	Total:	**20,548**	**290,065**	**10,011**
Other Private	Road:	208	20	0
	Water:	406	9,700	97
	Total:	**614**	**9,720**	**97**
Grand Total:		**25,103**	**602,253**	**13,135**

Table 2. Approximate harvest date of immature forest and forest statistics

Approximate time of harvest	Acres	Standing Volume (BDT)	Maximum AAC (BDT)
1960-1980	5,197	67,564	4,161
1980-1995	1,737	0	1,391
1995-2000	2,686	0	2,150
Natural Stand	3	39	2
Grand Total	**9,623**	**67,603**	**7,704**

Higher value forest products

Traditionally, woody biomass has been thought of as residuals and waste from logging and milling operations. Woody biomass projects have been able to take advantage of this material and obtain it at low cost resulting in economically feasible biomass projects. In Port Graham, a feasible wood based biomass project requires harvesting purely for biomass as no local forest industry exists. The maximum AAC estimate for the Port Graham vicinity includes all woody forest products including saw logs and other high value forest products. Historical timber appraisals and logging operations near Port Graham show that roughly 40% of total forest volume is saw logs or other high value forest products. These products are worth more to the landowner as saw logs than biomass harvests; landowners undoubtedly will demand high prices for this material or sell it to buyers willing to pay for higher quality wood. Consequently, biomass harvest could revitalize past forest product markets allowing landowners to sell products for the highest value, potentially reducing the biomass supply by 40%.

Varying landowner participation

The Port Graham vicinity contains one large land owner (Port Graham Corporation) and numerous small holdings. There are 39 Native Allotment parcels with an average size of 124 acres. The owners of the Native Allotments have a wide range of goals and objectives for management of their property ranging from preservation to maximum economic benefit. It is unlikely that all allottees will be willing to sell biomass. Estimating the participation of Native Allotments in biomass sales is beyond the scope of the assessment and would be pure speculation but should be considered when sizing biomass projects. The participation of Native Allotments will be critical to biomass projects at the large end of the spectrum as Native Allotment ownership control 57% of all mature timber volume (Table 3.) in the Port Graham vicinity.

Table 3. Ownership, standing volume, and maximum annual allowable cut of accessible mature timber

Land Owner	Acres	Standing Volume (BDT)	AAC (BDT)
Native Allotments	3,938	302,428	3,024
Port Graham Corporation	3,111	222,502	2,310
Total	**7,049**	**524,930**	**5,334**

Natural forest disturbance

The effect of natural disturbances on forests can be dramatic. For example, the 1990's spruce bark beetle outbreak caused the mortality of 1.4 million acres of spruce forest on the Kenai Peninsula and recent windstorms, 4 miles east of Port Graham corporation timberland, have caused large areas of blowdown (figure 2). Natural disturbances such as spruce bark beetle and windstorms are the major causes of forest mortality in the Port Graham vicinity. It is extremely difficult to predict the location and timing of blowdown events and spruce bark beetle outbreaks but over the course of the 100 year rotation period these disturbances will most definitely occur. When they do occur, the forest can be salvaged logged to extract useable biomass and timber however planning for these disturbances is difficult and problematic at best.

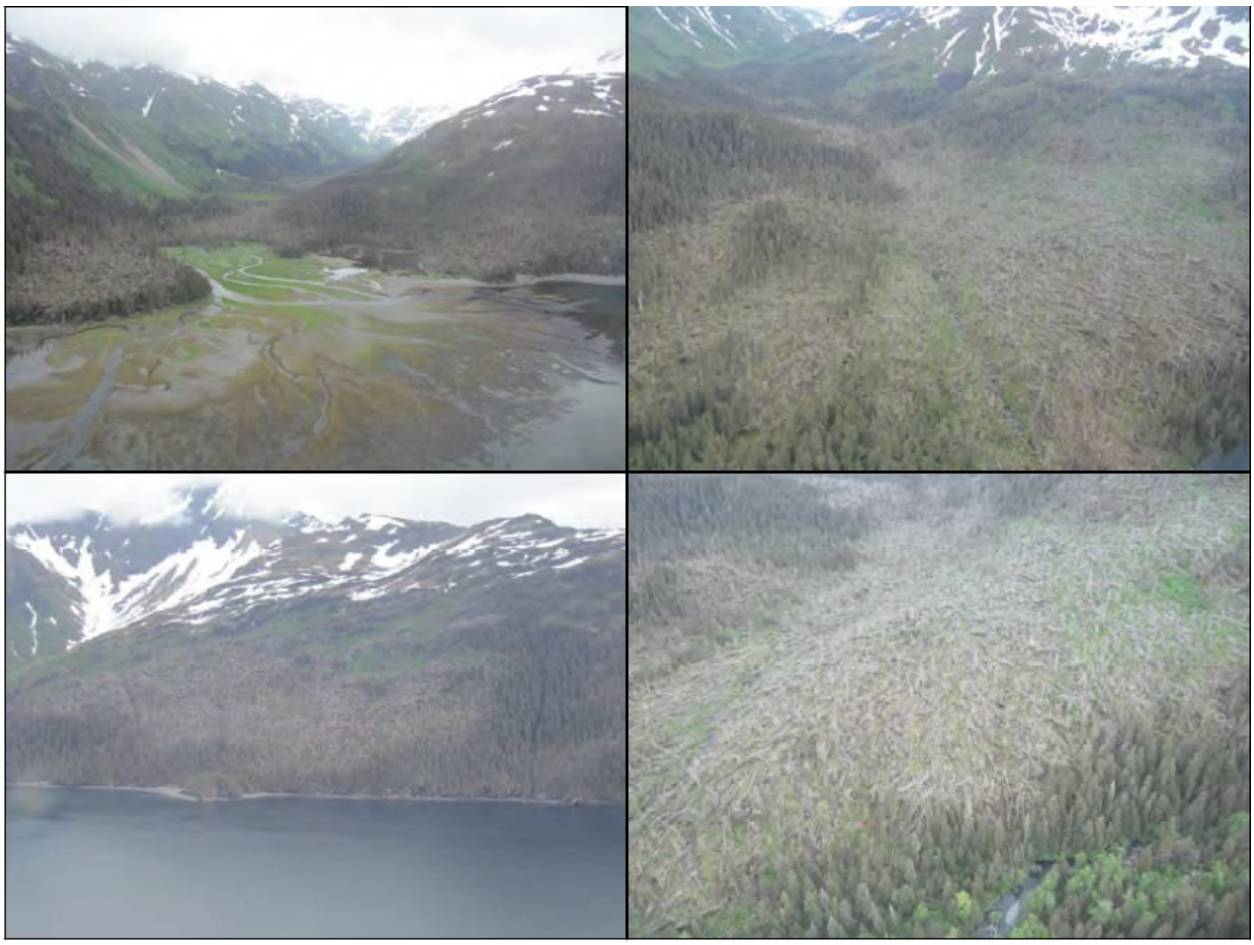

Figure 2. Spruce blowdown that occurred in late 2011 at the head of and along the West Arm of Port Dick 4 miles east of Port Graham Corporation timberland (photos courtesy of Ed Fogels, AKDNR Commissioner's Office; June 20, 2012)

Potential factors leading to an increase of the maximum AAC

The AAC could be increased in the Port Graham vicinity by the addition of additional timberlands or a shortening of the rotation age. In the following section the potential increases to AAC will be discussed as well as the magnitude of the increase.

Additional timberlands

There are two potentially large additions to available timberlands that could occur in the Port Graham vicinity. First, a new airport is being designed to jointly serve Port Graham and Nanwalek and would open up all timberlands accessible from Nanwalek. Geotechnical engineering and design work is ongoing as of this writing and the project will likely be completed in the next 5-10 years. As part of the new airport a roughly 2 mile all season road will be constructed linking Port Graham and Nanwalek (figure 4). The Nanwalek vicinity contains an additional 16 Native Allotments (2,300 acres) as well as English Bay Corporation timberlands (2,800 acres) totaling roughly 5,100 acres easily accessible by existing roads. The current AAC estimate included only 16,780 acres of timberland; an additional 5,100

acres may increase the AAC by 33%. In addition, access to Native Allotments west of Port Graham would change from water access to road access likely lowering extraction costs (figure 4).

Second, the old logging road heading north from Rocky Bay used to connect with Seldovia Native Association logging roads north of Port Graham Corporation's holdings. Repair and improvement to this road could provide access to Seldovia Native Association's timberland. Although vegetation typing has not been completed for Seldovia Native Association holdings, they are likely similar in size to Port Graham Corporation's holdings. Seldovia Native Association's holdings have not been researched but assuming they are similar to Port Graham, they could likely provide an increase to the AAC of 50%-100%.

The 8,137 acres not vegetation typed and not included in AAC figures during this analysis could be vegetation typed and included (orange color lands in figure 1). Approximately 250 acres directly adjacent to Port Graham which are owned by Port Graham Village Council could be added if the Port Graham Village Council is willing to harvest timber directly adjacent to Port Graham. The Port Graham Corporation lands located east of Port Graham Bay and West of Rocky Bay (Figure 3) could also be included. These lands were reserved from timber harvesting in the 1990's primarily because of their proximity to salmon streams. Port Graham Corporation elected to leave 300 foot stream buffers when the maximum required by Alaska state law is 100 feet. This area contains 2,610 acres of the total non-vegetation typed land, some of which could be harvested for biomass. This area may increase AAC slightly (up to 5%) but not near the magnitude of road connection to new timberlands.

Shortening of the Rotation Age

With active forest management it may be possible to shorten the rotation age of a forest stand. For example, growing a mature forest in 75 years instead of 100 years would increase the maximum AAC from 13,135 to 17,513 BDT or 33%. Forest growth and yield data has not been collected for the Port Graham vicinity or neighboring lands but biased on observation of local regrowth a 75-100 year rotation age is reasonable for the area.

Recommended AAC

Taken together, the factors potentially lowering the AAC require a more conservative AAC in order to be prudent. Here, a range of AACs will be presented that are more conservative, and more likely to avoid accidental unsustainable biomass harvests in the Port Graham vicinity. While there may be no one "correct" AAC, the landowners and residents of Port Graham will have to determine what AAC is acceptable to their way of life and fits their local needs for timber resources. It is difficult and problematic to account for the effects of natural disturbance on AAC and data on land owner participation is currently unknown. These factors, while important, will not be considered as part of this exercise.

The most conservative AAC would include only mature forest, leaving out growth from the 9,623 acre immature forest, and reserve 40% of total volume for higher value timber products. This approach results in an AAC of 3,259 BDT. A more moderate approach would be to reserve 40% of total forest volume for higher value timber products and limit the AAC to available mature timber for the first 50 years. After immature forest begins to mature the AAC could be adjusted up to reflect the changing

forest conditions. An AAC of 6,578 BDT is achievable in the next 50 years. For the initial AAC, the recommended range is between 3,259 and 6,578 BDT. This range should be updated periodically as forest conditions change.

There is great potential to increase the recommended AAC range. The addition of timberlands could have the greatest effect on increasing AAC. Adding Seldovia Native Association, English Bay Corporation, and neighboring Native Allotment lands have the potential to increase to increase the AAC from 5%-138%. Shortening rotation age of the forest through active forest management could also significantly increase the AAC. When rotation age of forest stands is shortened to 75 years from 100 years the AAC is increased an additional 33%. Taken together, the potential to increase AAC by 38%-171% is realistic.

Methods

Analysis Area

The analysis area for the biomass resource assessment includes lands accessible from Port Graham by water and road across all ownerships and is referred to as the "Port Graham vicinity" throughout this document. The area analyzed was limited to Port Graham Bay and the logging road system to Windy Bay and Rocky Bay as well as the planned project. Harvest distances were limited to 1000 feet from roadways and 2000 feet from water accessed stands. After restricting the analysis by harvesting constraints a total of 25,103 acres of land is accessible to timber harvest. Of the 25,103 acres, 8,323 acres were not vegetation typed and were dropped from the analysis (figure 1). A planned airport construction project is expected to clear roughly 150 acres of land and build a new road linking Port Graham to Nanwalek. The project is primarily in heavily timbered lands and aside from land clearing will also change the accessibility of surrounding lands from water to road access (figure 4).

Computer Software

This biomass resource assessment relied heavily on ArcGIS 10.0 a computerized geographic information system (GIS) from ESRI. The GIS was used to spatially define the resources (forest stands) on the ground and attributes associated with those resources. Attributes of interest for this assessment include forest type, access type, and distance from access point, land owner, and harvest history. These data where compiled using existing vegetation typing conducted by Chugachmiut on Native Allotments and Native Corporation lands, digital air photography, catalogue of anadromous streams, local road system, and other digital data.

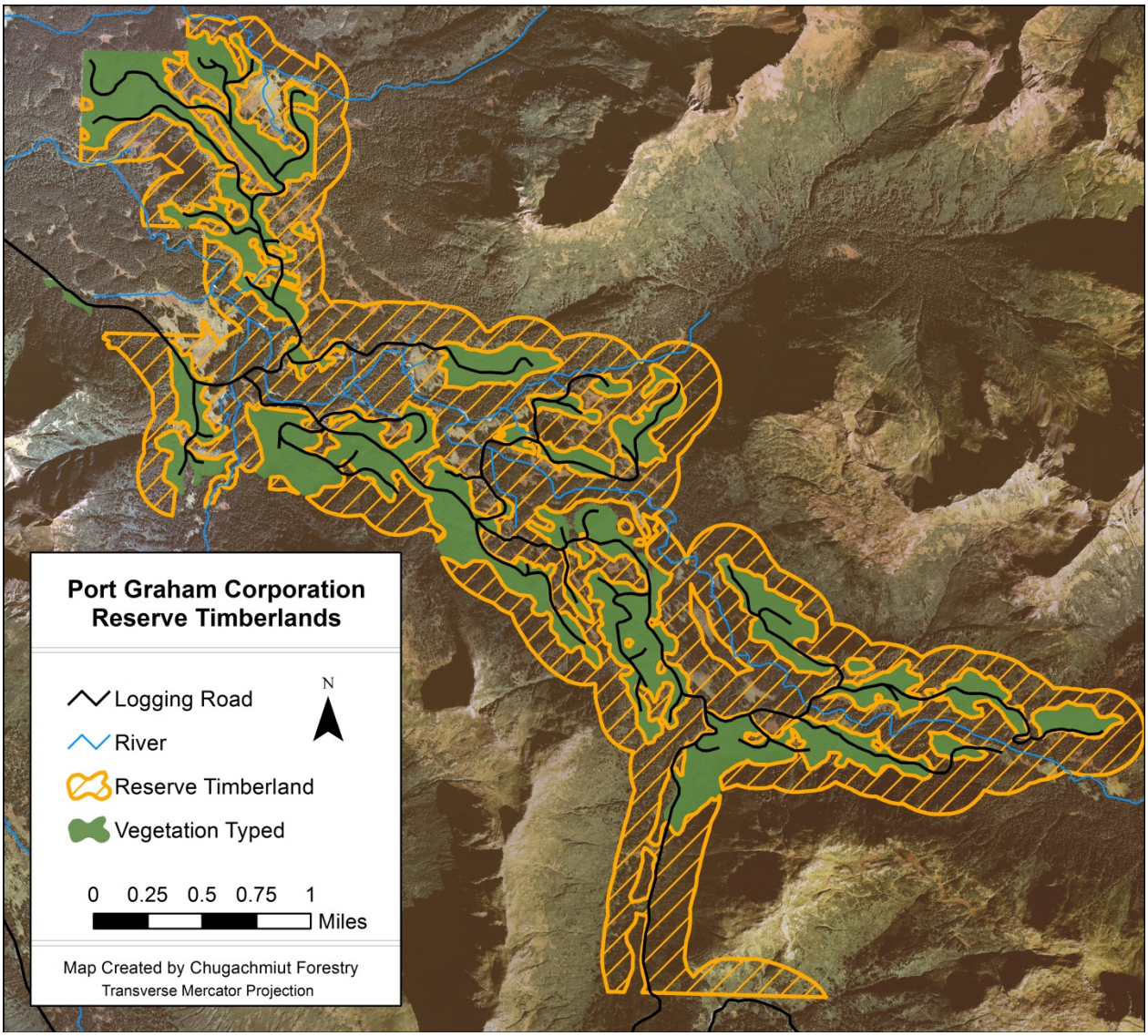

Figure 3. Port Graham Corporation reserved timberlands which could be harvested for biomass

After spatial analysis in the GIS data, tabular data was exported into a spreadsheet (Microsoft Excel 2010) for manipulation and summary. The spreadsheet was used to relate the spatially analyzed data with timber inventory data and tabulate available timber volume for biomass use, and to create tables and figures.

Land Ownership

Land ownership data was compiled from three sources. Native allotment data was obtained from Chugachmiut land records and the Bureau of Land Management Spatial Data Management System (BLM, 2012). Ownership information for Alaska Native Corporation and other land owners was obtained from the Kenai Peninsula Borough's GIS webpage (KPB, 2012)

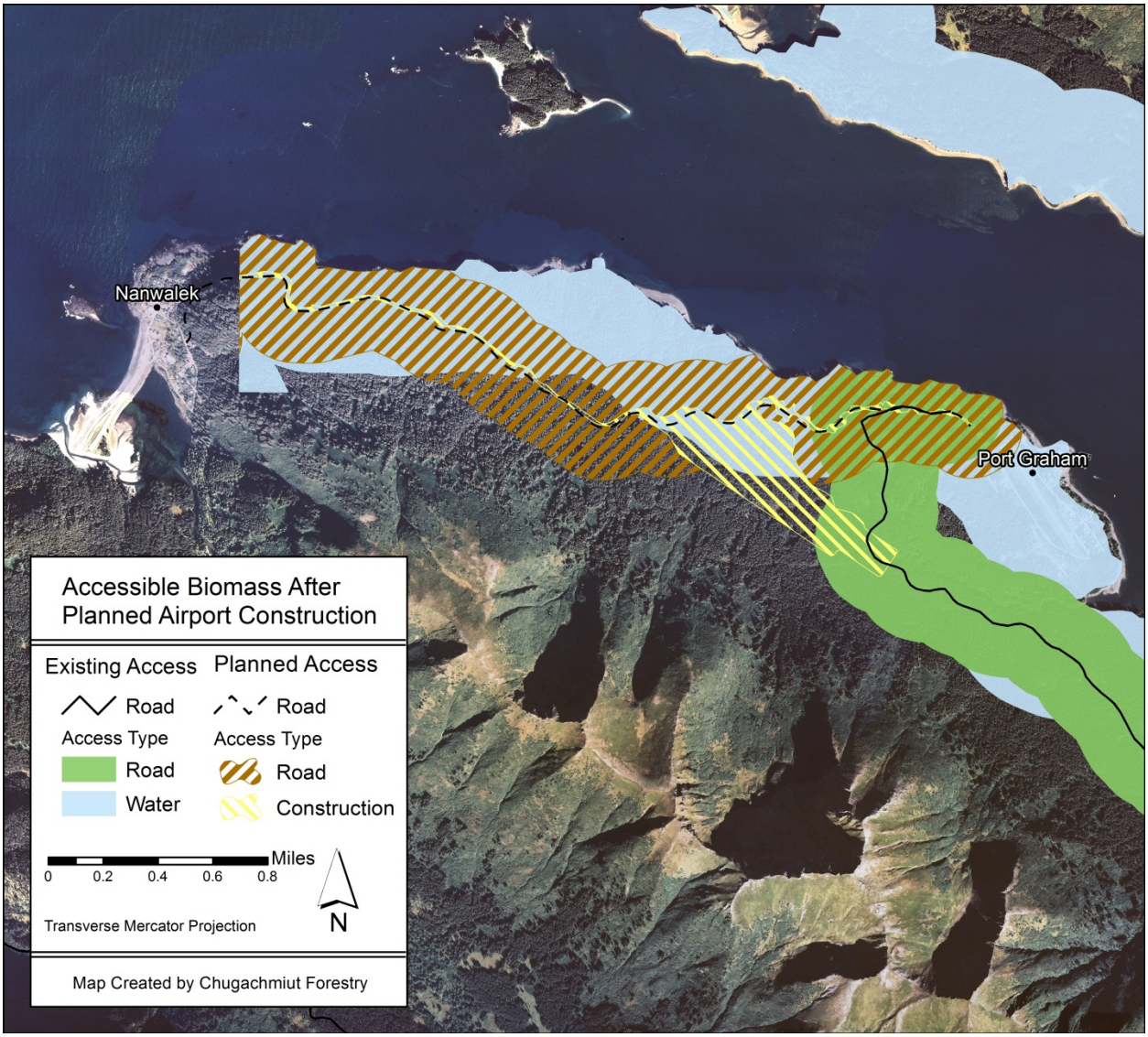

Figure 4. Accessible biomass from Port Graham and the type of access after airport construction project has been completed.

Vegetation Typing

All vegetation typing was conducted following the Bureau of Indian Affairs Alaska Regional Office protocols (Wilson, 2005). Individual stands or cover type polygons were delineated and attributed for a vegetation type. Aids used in the interpretation of vegetation types on aerial photography include color, texture, hue and physical location of the stand in question. Forested stands were attributed for primary tree species (Table 4); species size class (Table 5), secondary species, and crown density (Table 6). Non-Forested stands were coded for broad vegetation types including shrub lands, wetlands, and non-forested vegetation types.

Vegetation typing was conducted in two efforts by Chugachmiut; one effort in the late 1990's in combination with harvest planning on Port Graham and English Bay Corporation lands. The first effort

was primarily limited to past and planned harvest units. The latest vegetation typing occurred in conjunction with Native Allotment timber inventory conducted in 2011 and 2012 including all Native Allotments and limited private property. Of the total accessible land 8,323 acres were not vegetation typed, of these acres 7,816 were acres not included in the 1990's vegetation typing effort. The 7,816 acres was land deemed not viable for timber harvest in the 1990's and therefore was not vegetation typed as part of this assessment despite that fact that some of the 7,816 acres have harvestable biomass. The remaining 507 acres not vegetation typed are owned by Port Graham Tribe (369 acres) and other private land owners (139 acres).

Remote sensed imagery

The vegetation typing described above was conducted using aerial photography from various sources and dates. Native Allotments were vegetation typed using color air photography flown for Chugachmiut in 2003. Imagery used for the 1990's vegetation typing effort was not documented but was likely black and white air photography flown in the 1990's.

Forest Inventory

Forest inventory was conducted primarily on the Native allotments during October of 2010 and October of 2011. All data was collected with AK_OpTICS v 1.0c beta and compiled with AK_OpTICS v 2.0c beta software which was developed by Thomas E. Burk for the BIA Alaska Regional Office. Strata statistics from the 2011 timber inventory are presented in table 7. Of the cover types identified during vegetation cover typing only cottonwood (CW) and Sitka spruce (SS) cover types contain commercial timber so inventory was limited to these strata. We used an area weighted sampling design to select forest stands to be sampled; with this sampling design, larger stands are more likely to be sampled than small stands. As shown in Table 7, stands in the Cottonwood (CW) stratum were not sampled; this is because the stratum includes only 99 acres (16,319 acres are in the Sitka spruce (SS) strata) lowering the probability any stands would be selected in our sampling design.

Table 4. Vegetation cover types

Vegetation Cover Types			
Forestland			
CODE	Conifers	CODE	Hardwoods
SS	Sitka Spruce	BI	Paper Birch
		CW	Cottonwood
		RA	Red Alder
Shrubland			
DM	Dry Meadow	TS	Tall Shrub
DS	Dwarf Shrub		
Wetlands			
B	Bog	TSw	Tall Shrub wet
DSw	Dwarf Shrub wet	W	Lakes/Ponds
R	River/Flowing Water	WM	Wet Meadow
SW	Intertidal		
Non-forest			
BA	Bare Ground	CURD	Roads/Airstrip
SA	Sand	CUST	Structure

Table 5. Tree species size classed

Average Size Class		
Type	*Code*	*Size*
Dwarf Forest	D	<25 feet tall
Reproduction	R	1.0 " to 4.4" DBH
Poletimber	P	4.5" to 8.9" DBH
Sawtimber	S	9.0" and greater

Table 6. Stand crown density

Stand Crown Density		
Type	*Code*	*Percent canopy closure*
Low	1	10% to 40%
Medium	2	40% to 60%
High	3	60% and greater

Table 7. Strata sampled during the Chugach Region 2011 forest inventory and associated statistics[2].

Stratum	# of	BDT/Acre	Standard Error	Sampling Error
SSS 3	240	88	2.64	3%
SSS TS 1	20	34	12.24	36%
SSS TS 2	50	57	4.56	8%
SSS TS 3	40	64	4.48	7%
SSS WM 1	10	4	2.16	54%
SSP 2	45	13	1.04	8%
Combined	405	74	1.48	2%

Table 8. Sampled stratum biomass value assigned to vegetation types not sampled in forest inventory.

vegetation type	assigned stratum biomass value
SSP	SSP 2
SSP 3	SSP 2
SSP 2	SSP 2
SSP SSS 2	SSP 2
SSR	Not assigned
SSR 2	Not assigned
SSS 3	SSS 3
SSS 1	SSS TS 1
SSS TS 1	SSS TS 1
SSS TSw 1	SSS TS 1
SSS 2	SSS TS 2
SSS TS 2	SSS TS 2
SSS TSw 2	SSS TS 2
SSS TS 3	SSS TS 3
SSS WM 3	SSS TS 3
SSS WM 1	SSS WM 1
CWP 2	Not assigned
CWS SSS 2	Not assigned
CWS SSS 3	Not assigned
CWS TSw 1	Not assigned

Assigning Harvestable Biomass to Stands

All stands were assigned a vegetation type call but the forest inventory sampling design did not sample all vegetation types. In all, 39 unique vegetation types were identified, only 20 of which were considered

[2] Abbreviations for strata are Sitka spruce (SS), tall shrub (TS), wet meadow (WM), sawtimber (s) , poletimber (p) and density classes (1,2, or 3).

"commercial", or stands that can support biomass harvesting. "Commercial" vegetation types where those dominated by Sitka spruce (SS) and Cottonwood (CW). Of the 20 "commercial" vegetation types 6 were sample strata in the forest inventory (table 7). When appropriate, biomass values from stratum of similar vegetation were assigned to vegetation types not sampled (Table 8). In the case of reproduction (SSR) and cottonwood (CW) types, no similar strata were sampled so biomass values were not assigned for these vegetation types.

Annual Allowable Cut

The traditional method to quantify a sustainable forest harvest level is the concept of Annual Allowable Cut (AAC). Simply put, AAC is the maximum annual harvest level that can be sustained in perpetuity. For the Port Graham vicinity two general forest conditions exist, mature forest and immature forests. To account for this variation in forest condition we used the Hanzlik formula for AAC. The Hanzlik formula considers the available volume in mature forests and potential volume from immature forests as growth, specifically Mean Annual Increment (MAI). The formula used is:

$$AAC = \frac{Mature\ Forest\ Volume}{Rotation\ Age} + MAI$$

In the Port Graham area no MAI data has been collected and growth and yield programs such as the Forest Vegetation Simulator have not been calibrated for use. No Site Index data has been collected on the immature stands. Taken together, the empirical data does exist in the analysis area to calculate MAI. In order to estimate the MAI we used the following formula:

$$MAI = \frac{Area\ of\ Imature\ Forest\ x\ Average\ Mature\ Forest\ Volume}{Rotation\ Age}$$

In order to use the Hanzlik formula we must make four key assumptions

1. The rotation age in the analysis area is 100 years
    a. This assumption is conservative and an optimum rotation age is likely 75-100 years
2. The same volume will be realized in immature forest stands as the Mature Forest stands
    a. In actuality, with active forest management such as pre-commercial thinning and forest thinning, higher total volume will likely be harvested over the life of the stand.
3. The same percentages of vegetation types are present in the immature forest area as mature forest.
    a. Logging operations typically target forest stands with the best wood quality and highest volume which are normally found on the most productive sites. The immature (previously logged) forest undoubtedly contains a disproportionate amount of the high productivity sites. By using the average volume of mature timber in the MAI equation, which includes a mix of all site productivity, we are likely underestimating MAI.
4. Forest stands are mature at 100 years (rotation age).
    a. Site index trees sampled in forest inventory are generally 100- 120 years old indicating the mature forest stands are 100-120 years old. If stands are closer to 120 years old MAI will be overestimated.

Cost Analysis

A formal cost estimate was not conducted as part of this assessment. Estimating cost of biomass is difficult and problematic at this stage of the project because many factors important for estimating costs of biomass are unknown. Key unknown factors include type of harvesting equipment and total amount of required biomass. Biomass costs should be considered on a project by project basis.

For the proposed GARN boiler project, an estimated 100 bone dry tons (BDT) per year of biomass is required. The GARN boiler project would require slightly more than 1 acre of clear cutting in the SSS 3 vegetation type annually. Traditional cost calculations for forest logging operations are built for logging more extensive areas with industrial logging equipment which are not cost effective for one to two acres and thus are irrelevant. For a one to two acres size operation an individual or crew with a chainsaw and a truck can extract biomass and costs associated with this operation should be used to determine the cost of biomass. The local cost of fire wood is a good estimate of cost for the GARN boiler project; a cost of $160-$200 per BDT ($200-$250/chord) is reasonable.

For larger projects where industrial equipment can be used efficiently a more traditional cost estimate using the derived residual value method can be used for estimating biomass cost. Cost for the derived residual value method can be obtained from the US Forest Service and the State of Alaska Division of Forestry and adjusted as needed to meet local conditions near Port Graham. Cost for water accessible stands will be higher than observed on US Forest Service timber sales because the size of harvest in the analysis area are smaller than those of the Forest Service and capable contractors are not available locally.

Conclusions

The Port Graham vicinity has abundant forest resources, a developed forest road system, and is an ideal location for biomass energy projects. With 16,786 acres of accessible timberland and the potential to add more, Port Graham has enough timber resources to meet its energy needs and more. The recommended range of AAC to use when sizing biomass projects is between 3,259 and 6,578 BDT. This recommended AAC range is at least 30 times greater than the projected need for the GARN boiler project of 100 BDT/year. The recommended AAC is a significantly lower than the maximum AAC of 13,135 but it accounts for the 50 year supply of available stand biomass, after which immature stands will begin to reach maturity and reserving 40% of forest volume for higher value forest products such as saw logs. The participation of Native Allotment owners will be crucial for any biomass operation that requires over 1,400 BDT/year Native Allotment owners control the majority of mature standing timber. The recommended range does not account for future natural disturbances or varying participation by landowners, but that is ok as AAC is not a static figure and should be revisited on a periodic basis whenever significant changes to forest resources occur. Significant changes to forest resources may include but are not limited to, new landowner goals and objectives, natural disturbances, improved growth and yield information, addition of new timberlands, and vegetation typing of previously un-typed lands.

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Forest Management Plan for Native Allotments in the Chugach Region of Alaska

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Chugachmiut Forestry Program
Anchorage, Alaska
September 21, 2012

Forest Management Plan for Native Allotments in the Chugach Region of Alaska

Chugachmiut: _____

Title: Executive Director

Date: Dec. 04, 2012

Bureau of Indian Affairs
Alaska Regional Office: _____

Title: Regional Director

Date: 10-24-2012

I. Table of Contents

A. ***List of Figures***

B. ***List of Tables***

ACKNOWLEDGEMENT

Chugachmiut would like to thank the Tanana Chiefs Conference Forestry Program for developing the organizational structure of this management plan. It is through their hard work that we have a guiding document for management of forest resources on Native Allotments in Alaska.

II. Introduction

A. *Purpose and Need*

The purpose of this document is to present a plan for the management of the forest resources of individually owned Indian trust allotments. This plan provides policy directives for forest management activities to ensure adherence to statutory and regulatory requirements protecting timber, fisheries, wildlife, cultural and other resources on allotments within the Chugach region. These requirements arise primarily from the trust management responsibilities held by the U.S. government for these allotted lands, much of which has been assumed by Chugachmiut in the Chugach region through a Self -Governance Compact. Not only is the plan meant to assist with the fulfillment of trust management responsibilities, but federal regulations require the implementation of such a plan. The purpose of the plan is to assist in the effective management of forest resources on Native allotments in the Chugach region; the need is dictated by trust management responsibilities assumed by Chugachmiut and the federal regulations accompanying these responsibilities.

Within the constraints imposed by the statutes and regulations, the decisions affecting Native allotments are at the discretion of allotment owners and heirs. This plan applies to less than 100 Native allotment parcels and hundreds of owners of those parcels. As a result, it is beyond the scope of this plan to precisely define the desired actions and their locations to accomplish the management goals and objectives of the allotment owners. Rather, the plan attempts to present a series of Best Management Practices (BMP's) and alternatives to implementation, which are intended to help individual allotment owners make informed decisions about the management options that best meet their goals. These specifications are designed to provide appropriate management options to forest managers, project crew supervisors and others and assist in the formation of performance measures utilized in the operation of trust forestry programs. The plan can also serve as an educational tool for forest management practices for allotment owners and heirs, interested tribal governments, tribal members, interested members of the public and regulatory agencies.

The development of this management document has been guided by the National Environmental Policy Act (NEPA) and conforms to the spirit of NEPA. In addition to serving as a Forest Management Plan, this document also serves as an Environmental Assessment required by NEPA. The Environmental Assessment (EA) component of this plan is, as a result, a programmatic EA that can be referenced by NEPA documents required by individual specific proposed actions that may occur within the scope of this plan. Such "tiering" of environmental documents is encouraged by Federal regulations (40 CFR 1502.20) to help reduce repetitive documentation and discussions of the same issues. The EA represented by this plan is not meant to replace NEPA documentation required for site-specific management activities, but can be used to simplify the process of preparing required NEPA documentation through this tiering.

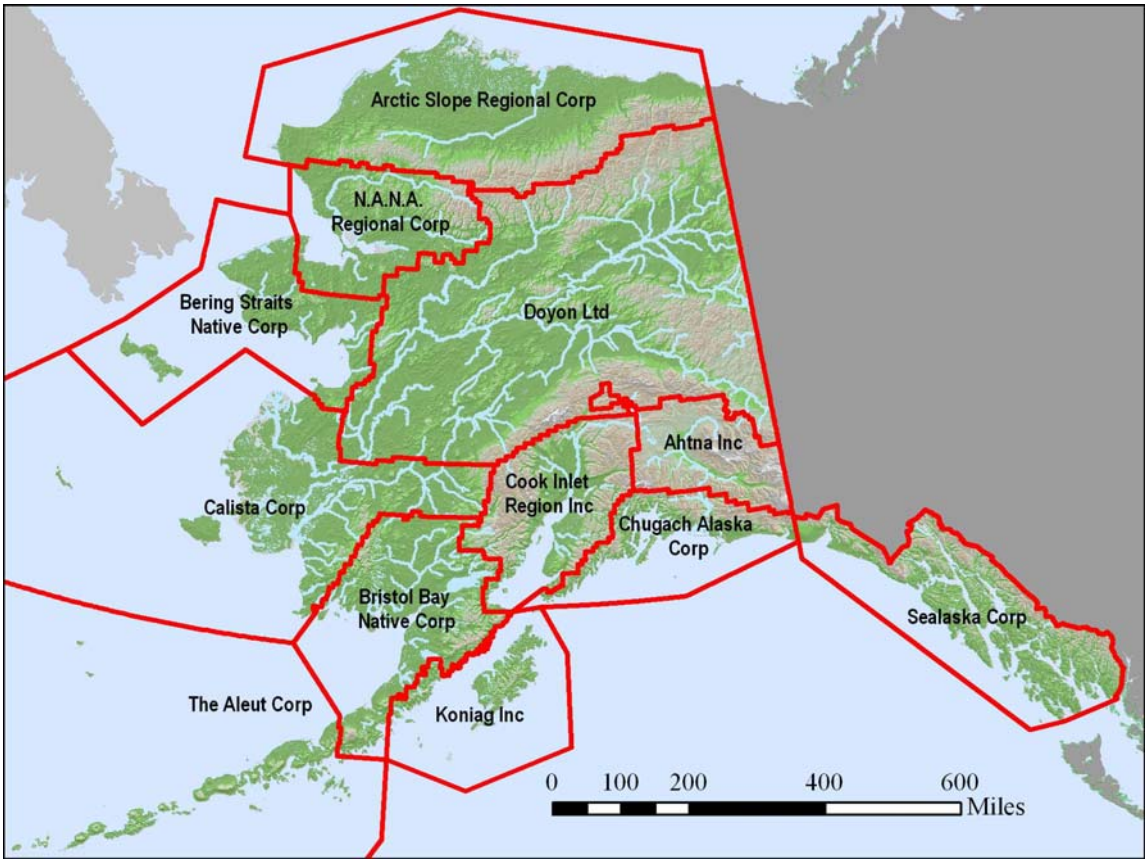

Figure 1. Regions as defined by ANCSA and associated Native regional corporations.

It is recommended that this document remain current until the plan no longer represents the allottees' goals, but a review should occur at a minimum interval of 10-15 years. This review could minimally include an updating of pertinent information, especially forest inventory information.

B. ***The Region***

The boundary of the Chugachmiut service area corresponds to the boundary of the Chugach Alaska regional Native Corporation that was established by the Alaska Native Claims Settlement Act of 1971 (ANSCA) (Figure 1.) Native allotments within the boundary are under the jurisdiction of the U. S. Bureau of Indian Affairs (BIA), Alaska Regional Office. Chugachmiut, through an Indian Self Governance Compact, has assumed forest management activities within this region. Native allotments administered by the BIA Alaska Regional Office are "restricted" lands because the titles to these parcels are held by individual Alaska Natives. The restrictions are against alienation and taxation. For all other purposes, Native allotments are managed by the U.S. Federal Government as "trust" Indian lands. Within this

context, those lands assigned to individuals are referred to as individually-owned Native allotments, and the individual owners are referred to as "allottees."

The region falling within the scope of this plan has been referred to in a variety of ways, including "Chugach region", "Chugachmiut region", and "Chugachmiut service area". In addition, the BIA, for the purposes of Native allotment forest management, refers to the region as the "Chugach Management Unit". Throughout this document, the region will be referred to as the "Chugach Region", with the understanding that this is synonymous with the other descriptors of the region.

C. *Goals and Objectives*

As mentioned previously, forest management activities are driven by the goals and objectives of individual allotment owners and/or their heirs. The opinions of allotment owners and interested tribal members were solicited by interviews with individual Native Allotment owners/and their heirs, a public opinion survey, and past experiences with forest management activities by Chugachmiut Forestry throughout the State identified a number of common allottee goals and objectives, including:

- To prevent unauthorized access and trespass;
- To generate income for the allotment owners and heirs;
- To produce sawtimber and houselog quality logs and fuelwood;
- To maintain and/or improve health of residual forest and reestablish a well-stocked free to grow stand after harvest;
- To prevent property and resource damage from uncontrolled wildland fire and forest insect outbreaks;
- To maintain wildlife use of the area; and
- To maintain and increase subsistence resources of the area

These goals are consistent with the overarching vision identified by the *Integrated Resource Management Plan for Nanwalek and Port Graham* (ASCG, 2007; ASCG, 2009) "To maintain and protect our cultural and traditional values, to guarantee our future, to promote our physical well-being and safety while striving to be socially and economically self-sufficient, developing the village, protecting our resources and continuing to advance our way of life."

D. *Authority*

The requirement for management planning on Indian trust lands is certified under 25 Code of Federal Regulations Part 163, "General Forestry Regulations". The regulations state that an "appropriate forest management plan shall be prepared and revised as needed for all Indian forest lands" (163.11 (a)). Additional references pertaining to the general authority of requirements presented in this document, including wildland fire use and control, are derived

primarily from the following sources, some of which also contain references to other pertinent statutes and policy documents for the management of Indian forests:

- National Indian Forest Management Act of 1990, Title 25 USC § 3101-3120.
- Indian Self-Determination and Education Assistance Act (P.L. 93-638) as amended
- Tribal Self-Governance Act of 1994 (P.L. 103-413)
- BIA 53 Indian Affairs Manual, Forestry
- BIA 59 Indian Affairs Manual 3-H NEPA Handbook 2005
- BIA Alaska Regional Office NEPA Handbook 2005
- DOI 516 Departmental Manual, Chapter 10; Managing the NEPA process – BIA (2004).

The processes and actions described in this document apply to Chugachmiut Forestry Program's activities on individual Native allotments. They are meant to comply with the Bureau of Indian Affairs Alaska Regional Office management practices but serve as a reference to provide further guidance under Federal oversight.

III. Summary of Alternatives

There are a great variety of potential management activities that fall within the scope of this plan. They fall into several broad alternatives in terms of how the process associated with a proposed activity is handled. Proposed actions beyond the scope of this plan, including actions directed primarily at management of another resource, land status, or region, would either be handled independently on their own merits or within the context of other planning or NEPA documents if they exist. The alternatives possible under the implementation of this plan include:

A. *Alternative 1 - Plan Not Implemented (No-action alternative)*

The No-Action alternative in this case means that a Forest Management Plan is not implemented. Any and all management activities would be individually evaluated on their own merit with regards to potential impacts, NEPA compliance, and compliance with other statutes and regulations, or not evaluated at all. Any past activities, having been executed in the absence of a plan, would fall into this category. Among other considerations, is out of compliance with BIA requirements for implementation of Forest and Fire Management Plans on restricted Trust lands.

B. *Alternative 2 - Proposed Actions with Plan Implementation*

C. *Alternative 2a - Proposed Actions with No Significant Impact*

Proposed forest management activities on Native allotments would be evaluated using the specifications and criteria outlined in this plan and completing action-specific NEPA analyses

tiered off of this document. Actions would be approved if they are deemed to pose no significant impact on the affected natural or human environment. Many proposed activities would, in and of themselves, qualify for a categorical exclusion under NEPA guidelines implemented by the BIA, but would additionally be evaluated for potential cumulative impacts by considering other activities occurring in the same time and/or geographic area. Those actions not immediately qualifying for a categorical exclusion would require the generation of an EA with much of the discussion and analysis tiered from this plan.

D. ***Alternative 2b - Proposed Actions with Mitigated Impacts***

Proposed forest management activities on Native allotments would be evaluated using the specifications and criteria outlined in this plan, and potentially significant impacts would be mitigated through modification of the activities or appropriate application of best management practices as discussed in this plan. A proposed action would generate its own site- and action-specific EA, but much of the required discussion and analysis could be tiered from this plan. Based on such analyses, a *Finding of No Significant Impact* (FONSI) could still be appropriately generated, and the activity could be approved.

E. ***Alternative 2c - Proposed Actions Resulting in Significant Impacts***

Proposed forest management activities on Native allotments would be evaluated using the specifications and criteria outlined in this plan, and potentially significant impacts may be determined to be possible with the inclusion of mitigation strategies in the application of the actions. Costs, as represented by negative impacts, would be weighed against the benefits, as represented by the positive impacts. If the benefits obviously and significantly outweigh the costs associated with the proposed action, an EA is prepared and the proposed action may be approved through a FONSI. If the benefits do not obviously outweigh the costs, or the proposed action involves some level of controversy, the analysis may require an Environmental Impact Statement (EIS) with a final Record of Decision (ROD). With either an EA or an EIS, as with the preparation of EA's in the previous alternatives, much of the required discussion and analysis could be tiered from this plan.

IV. Description of the Affected Environment

A. ***Description of Allotted Trust Lands***

Historical Perspective

The Native Allotment Act of May 17, 1906 authorized the Secretary of the Interior to provide up to 160 acres of land to individual Alaska Natives. Few qualified individuals applied for the land until the late 1960's. During this time period, upon the onset of the Alaska Native Claims Settlement Act (ANCSA), Native organizations began to spread the word that passage of

ANCSA would repeal the allotment act and thus effectively end the opportunity of obtaining an individual "Indian homestead". As a result of the dissemination of this information, thousands of filings were made in advance of the December 18, 1971 passage of ANCSA. Due to the sheer number of applications presented to the Bureau of Land Management (the agency in charge of adjudication), a large backlog of cases resulted and many of these cases still remain unresolved. To comply with section 14 (h) (6) of ANCSA, allotment applications were advanced when a cadastral survey was requested. A certificate of allotment, however, is not issued until the survey is approved and the final adjudication and site inspection is performed. Upon certification, the final parcel location may change.

Allotment Parcels and Acreages

Native Allotments within the Chugach Management Unit are under the jurisdiction of Chugachmiut and the Bureau of Indian Affairs (BIA), Alaska Regional Office. Native allotments are "restricted" lands because the titles to these parcels are held by individual Alaska Natives. The restrictions are against alienation and taxation. For all other purposes, Native allotments are managed by the federal government as "trust" Indian lands. Within this context, these lands assigned to individuals are referred to as individually-owned Native allotments, and the individual owners are referred to as allottees.

According to BIA's Land Titles and Records (LTRO) there are approximately 1.2 million acres of Native Allotments throughout Alaska held in restricted status by the United States government. Within the Chugach Service area there is approximately 86 pending, or certified Native Allotments. The total BLM surveyed acres for the Chugach Management Unit are approximately 9,025 acres (the GIS digitized acres vary slightly, 9,039, from the surveyed acres because of the method BLM used to digitize Native Allotment Master Title Plats). The management area was divided into two subunits titled the Kachemak Bay subunit and the Gulf of Alaska subunit. The Kachemak Bay subunit is made up of 60 individual Native Allotments totaling 7,569 acres and the Gulf of Alaska subunit is made up of 26 individual Native Allotments totaling 1,456 acres.

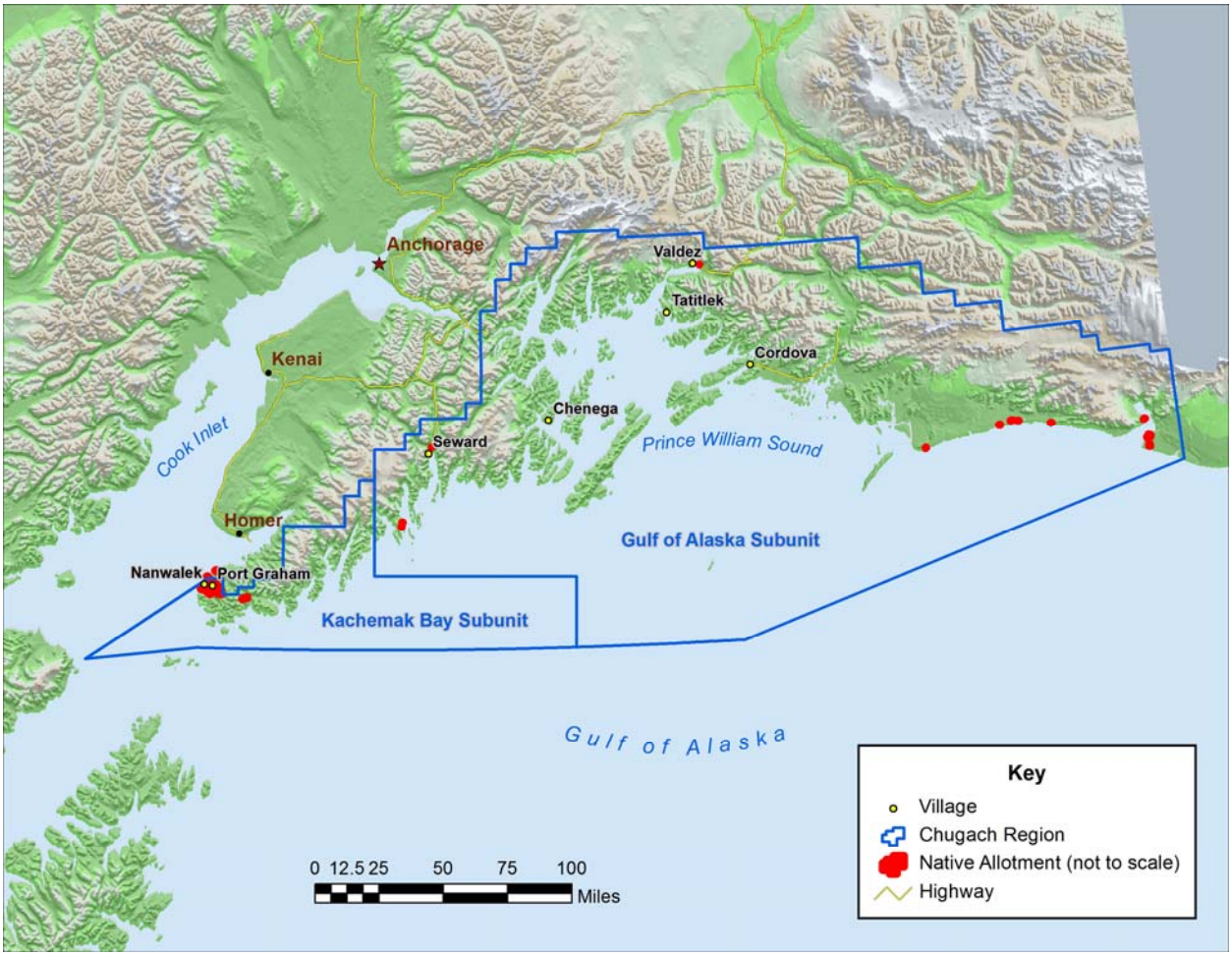

Figure 2. Native Allotments within the Chugach Region.

General Location and Ownership Pattern

In the Chugach Region Native Allotments are broken into two distinct groups; Native Allotments in the Port Graham/Nanwalek Vicinity and Native Allotments located along the coast of the Prince William Sound and the Gulf of Alaska. These two groups have been broken into two subunits; allotments in the Port Graham and Nanwalek area are titled "Kachemak Bay subunit" and all other allotments fall in the "Gulf of Alaska subunit" (see figure 2.). Generally more detailed resource data is available for the Kachemak Bay subunit and allotments in this subunit are managed by Chugachmiut. Most allotments in the Gulf of Alaska subunit are managed by the Alaska Regional Office of the Bureau of Indian Affairs.

Land Use

Many rural residents have an economy based on hunting, fishing and gathering activities that provide much of the food needs and some seasonal wage employment. Much of the land use on the allotments is based on these activities and occurs in relatively short time periods. Where allotments with developed fish camps occur, however, it is not uncommon for a family to spend much of the summer on their allotment.

Climate

a) Kachemak Bay Subunit

The Cook Inlet and the Chigmit Mountains moderate the climate in the Port Graham and Nanwalek area. The Cook Inlet contributes to temperature moderation and provides a ready supply of moisture. The Chigmit Mountains on the western side of the Inlet act as a barrier to the cold airflow into the area from Interior Alaska. The Kenai Mountains, rising sharply south of Port Graham, inhibit the flow of moisture-laden air from the Gulf of Alaska, making the area drier than expected.

The prevailing winds are west-northwest. Fair weather generally predominates during periods of north winds. Fog and precipitation prevail during periods of southeasterly winds. Winds of 20 knots or greater occur infrequently and are of short duration. Prevailing storm tracks in the area are from the west and west-southwest. Winds in the bay from the east-southeast cause the most trouble for navigation and on-land wind damage.

The weather in the Port Graham area is similar to that of Homer. The average annual temperature is 38.1°F. The average January temperature is 23.4 °F and the average July temperature is 54.1°F. Annual average precipitation is 25.45. (NOAA, 2010a) Freezing begins in late October to early November with frost penetration of up to two feet during most winters. Spring breakup occurs around mid-April. The mean frost-free period is 103 days. Thunderstorms rarely occur in the area. (NOAA, 2010b)

b) Gulf of Alaska Subunit

The Prince William Sound and Gulf of Alaska moderate the climate for Native allotments in the Gulf of Alaska Subunit. The large water bodies provide a ready supply of moisture for the area. The Alaska Range Mountains act as a barrier to cold airflow from the Interior of Alaska.

The weather in the Prince William Sound and Gulf of Alaska varies throughout the subunit but is generally wetter than the Kachemak Subunit. The average annual temperature in Cordova, AK is 39.1°F. The average January temperature is 24.6 °F and the average July temperature is 54.5°F. Annual average precipitation is 96.26 inches (NOAA, 2010a). Freezing begins in late October to early November with frost penetration of up to two feet during most winters. Spring breakup occurs in April. The mean frost-free period is 103 days. Thunderstorms rarely occur in the area. (NOAA, 2010b)

B. ***Air Quality***

The Chugach region experiences exceptional air quality when compared to Lower 48 environments. This is mainly due to its remote location and lack of industrialized development. Pollutants that have been found in Alaska's air, as recorded by an air monitoring station in Denali National Park 317 miles to the north and the Texedni Bay station 50 miles north west across the cook inlet, have been identified as small amounts of iron and silicon. These elements have been traced to large dust storms over the Gobi desert in China and Mongolia. These storms are large enough to pick up pollutants over China and Japan and carry them to Alaska via the jet stream. The Denali station also has registered arctic haze which is comprised of pollutants from the former Soviet Union and Eurasia. The sulfur compounds and black carbon particles come from metal smelting factories and coal burning plants. The haze is present in the cold months between November and March depending on the location of the polar air mass. The Texedni Bay station is primarily set up to monitor visibility and the worst air quality days are in July and August. The high July and August readings are from high levels of sea salt from ocean spray, Organic matter carbon and Coarse Mass particulate which are associated with wildfires that typically burn in July and August in Alaska. Although these pollutants have been recorded, air quality is still excellent and visibility typically exceeds 160 miles. The Denali and Texedni Bay air monitoring station have average B_{ext} (a measure of attenuation of light due to scattering and absorption as it passes through a medium) values of 8.8 Mm^{-1} and 12.9Mm^{-1} respectively compared with 46 Mm^{-1} for the Point Rays national seashore station, which is located away from major population centers in the Lower 48 states.

C. ***Cultural Resources***

At the time of contact, the lower Kenai Peninsula was primarily occupied by Pacific Eskimo people, who were called Unegkurmiut—"those people over there"—by their closely-related neighbors in Prince William Sound, though they called themselves Sugpiat, which as with most Alaska Native autonyms translates as "real people". However, occupation of the lower Kenai Peninsula had likely shifted over time between the Pacific Eskimo and the Tanaina Indians, who lived not far to the north at the time of contact.

British Captain James Cook is the first European known to have explored Kachemak Bay in 1778, and in 1786 Captain Nathaniel Portlock visited the area, and gave the name "Graham's Harbor" to the body of water that is now known as Port Graham, but the British did not maintain a presence in the area. In 1785, Russian fur traders had established a post at what is now Nanwalek; by 1790 they had built a fort there, which they called Alexandrovsk. The first Russian Orthodox priest visited Alexandrovsk sometime between 1785 and 1795, and a Russian Orthodox Church was built there in the 1860s; the present-day church in Nanwalek sits on the site of this original church.

Frederica de Laguna was the first to perform archeological field work in Kachemak Bay. The site she excavated on Yukon Island in the 1930s became the type-site for the Kachemak cultural tradition. The bearers of the Kachemak Tradition appear to have been in the area between 3,000 and 1,500 years ago. Artifacts typical of this tradition include ground slate ulus, knives, and projectile points, fishing implements (notched and grooved net sinkers, barbed compound fish hooks), stone lamps, barbed dart heads, and labrets.

Older sites have been found in Kachemak Bay, including sites of the Ocean Bay Tradition (circa 4,500 years ago), characterized by long, slender ground slate lance points and flaked stone tools, and sites of the Arctic Small Tool Tradition (circa 4,000 years ago) distinguished by a lack of ground stone tools, extensive use of exotic stones for flaked stone tools, including small arrow-tips, and shouldered, bifacial flaked knives.

There are two National Register eligible sites within the immediate vicinity of Port Graham and Nanwalek; a third site is in the process of being certified eligible. The English Bay River Falls Site (SEL-239) is a small late-prehistoric settlement located on the banks of the English Bay River, which today supports a runs of salmon, trout, and Dolly Varden. The site appears to have been briefly occupied (possibly used seasonally more than once) sometime between 300 and 500 years ago; two house depressions and six small cache pits were documented. A stone tool was recovered from a shovel test inside one of the house depressions. The Selenie Lagoon Archaeological site (SEL-064) consists of an actively eroding shell midden, located approximately 2 miles northwest of the Native Village of Port Graham on the north shore of Port Graham. The midden deposit is at least 3 meters high and runs for approximately 13 meters along the shoreline—it is unknown how far inland the midden extends. Bone is present in the midden, indicating good organic preservation. Subsurface testing of the midden has not been done, so both the precise nature of the deposit and the time period represented are unknown. The site being considered for inclusion on the National Register of Historic places is the Civilian Conservation Corps (CCC) trail connecting Port Graham and Nanwalek (SEL-348). The trail, including 19 wooden bridges was constructed circa 1937, and incorporates portions of an earlier foot trail used to travel between the two villages once Port Graham was established (circa 1897).

The deteriorated remains of a fox farm, which was in operation from 1916-1933, were documented on Passage Island, at the mouth of Port Graham. While the owners were non-Native, Natives from Port Graham worked at the fox farm; according to a knowledgeable Port Graham resident, mink were also raised there at one time. Prior Native use of Passage Island is demonstrated by the presence of three small prehistoric sites.

The village of Port Graham was established in 1897. A short-lived herring saltery and an Alaska Commercial Company (ACC) store opened there in 1907. In 1911, the ACC store building was converted to serve as a cannery, which operated seasonally through the 1960s. During the early

part of the 20th century, many Chinese workers came to Port Graham to work at the cannery, bringing their culture with them. Isolated finds of old opium bottles have been reported from the English Bay River above Nanwalek.

The types of sites that may be encountered in the area include village sites, fishing, hunting, and trapping camps, defensive sites (such as forts and refuge rocks), fox farms, and traditional and/or historic trails. The sites so far documented in the area lie either along the ocean shore or the banks of the English Bay River. However, the possibility of inland sites cannot be ruled out.

D. ***Water Resources***

The streams, lakes, and wetlands of the Chugach Region area are clear water systems with water quality characteristic of pristine watersheds. The streams support native populations of anadromous and resident fish species. Several threats to these conditions have been identified, including road building, planned timber harvest, and community development; however, there is no documented degradation of water quality conditions at the present time. Since the historical trail between the Port Graham and Nanwalek crosses water sources, its potential impacts on both villages' water quality must be considered.

Both Port Graham and Nanwalek derive their community water sources locally. The Port Graham watershed is approximately 424 acres in size and includes numerous streams that branch down from the mountains. The streams to the west of Port Graham feed a reservoir that has an intake structure for the water treatment plant. The average flows in these streams vary seasonally from 6.5 to 40.9 cfs (Dames and Moore 1999). This is more than adequate flow for any needs the community may have. In the winter, intake structure icing has caused problems with the treatment plant receiving water. Nanwalek's water source is a small dam located northeast of the village adjacent to a watershed. Consequently the flow depends on precipitation levels. Rain and snowmelt from the watershed collects in the dam where the water is then treated, disinfected and stored in a water tank. In 2002, Nanwalek began experiencing water shortage due to an unusually warm summer and low winter snowfall which reduced the amount of water in the watershed. In 2002 and 2003 the dam water level dropped so low that serious water rationing had to take place and water eventually had to be delivered from outside of the community. Working with Alaska Native Tribal Health Consortium engineers, the community identified Switchback Creek as a viable option to supplement the current water supply. Some of the Native Allotments in the management area fall in either the Port Graham or Nanwalek watershed. It is extremely important to protect water quality on these Native Allotments as there is the potential to affect the water quality for the villages.

The Port Graham/Nanwalek Watershed Council was formed to protect and preserve an area that includes two adjacent watersheds; English Bay River and Port Graham River and their tributaries. The two watersheds consist of approximately 100,000 acres of steep mountainous terrain and glacially developed river valley with elevations ranging from 3,000 feet to sea level.

The valley bottoms and lower slopes are covered with Sitka spruce old growth forests; alpine tundra meadows occur in the higher elevations.

The planning area represents a typical pristine marine coastal ecosystem of South-central Alaska. There is a large number of wetlands that provide high-quality spawning and rearing habitat for silver, king, pink, sockeye, and chum salmon as well as for Dolly Varden. Marine, estuarine, riverine, palustrine and lacustrine type wetlands are represented in the two watersheds. A large number of these wetlands provide high-quality spawning and rearing habitat for resident and anadromous fish. The majority of the Native Allotments in the area fall in either the Port Graham River or English Bay River watersheds. Poorly managed forest practices on the Native Allotments have the potential to negatively affect the pristine watershed for both the Port Graham River and English Bay River.

There are a number of smaller streams and water bodies in the area but Native Allotments do not typically include these water bodies. When a survey is conducted, property corners are set back from the water's edge as meander corners. The property line then connects these corners as a meander line. The allotment locations as depicted from the Bureau of Land Management's (BLM) database were developed by digitizing geo-referenced images of BLM's Master Title Plats. Due to inaccuracies of registration between the plats and the topographic maps allotments may include these water bodies. Newer digital survey grade data that is becoming available from BLM should alleviate most of these discrepancies in boundaries.

E. *Soil Resources*

Soil quality has a direct influence on the health of people, plants and animals. Productive forest land can be directly attributed to various soil characteristics such as the amount of organic material, drainage, and underlying permafrost. The process of soil identification is an important step in determining areas of productive forest land. Various levels of site productivity can be correlated to individual soil types. Detailed soil surveys usually contain estimates of soil productivity. Through these estimates, assumptions about productivity in timber stands not yet visited on the ground can be made, or in areas not currently stocked with timber, such as recently burned areas. Soil characteristics are determined by five interrelated factors: (1) parent material, (2) climate, (3) plants and animals, (4) topography, and (5) time (Jenny, 1941).

Kachemak Bay Subunit

Table 1 shows the acreage and percentage of each soil type represented in the Kachemak Bay subunit. The majority of soils in the unit are suitable for forestry uses (figure 3). Most of the soils in the management unit (80.1%, 6654.9 acres) fall within the Kasitsna complex. Soils in the Kasitsna complex are typically very deep, well drained. Parent material for these soils is volcanic ash over glacial till. Several minor soil components exist within the major Kasitsna complex: the Nuka, Tutka, Seldovia, and Seldovia-Port Graham. Other soil complexes are

present within the proposed project area and include the Chenega; Jakolof; Nanwalek; Ismailof; Koyuktolik and Nuka peats; Taluwik, Cryodos-Cryorthents, and Typic cryaquents. Soil components in the subunit vary in many of their characteristics but typically have parent materials of volcanic ash, glacial till, and may have thick organic soils or peat.

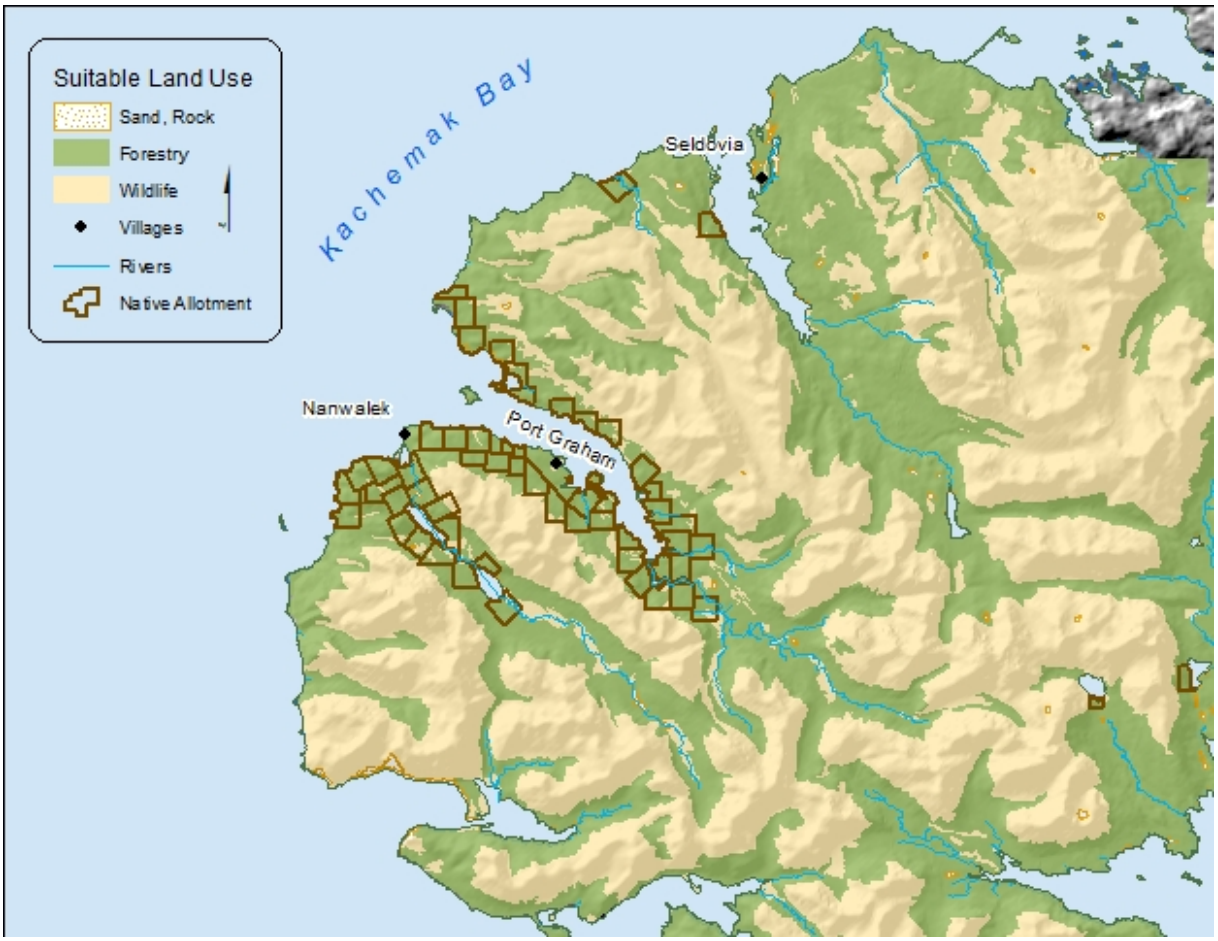

Figure 3. Suitable Land Uses from the Soil Survey of Lower Kenai Peninsula Area.

Gulf of Alaska Subunit

The United States Geological Survey has not collected soil survey data for Native allotments in the Gulf of Alaska management unit and soil information is unavailable for these Native allotments. Although soil survey data is unavailable, many of these Native allotments have relatively young soils and are influenced by glacial activity. For example, in the early 20th century a giant tidewater glacier extended to the Gulf of Alaska. Today the 30 mile retreat of the Guyot, Yahtse and Tyndall Glacier has uncovered Icy Bay, the surrounding lands, and the Gulf of Alaska.

Soil Type	Area (acres)	percent of area
BEACHES, GRAVELLY	8.02	0.11%
CHENEGA SILT LOAM, 0 TO 3 PERCENT SLOPES	64.23	0.84%
CHENEGA SILT LOAM, 3 TO 8 PERCENT SLOPES	33.18	0.44%
CRYODS-CRYORTHENTS-ROCK OUTCROP COMPLEX, 5 TO 120 PERCENT SLOPES	1.82	0.02%
ISMAILOF SANDY LOAM, 0 TO 3 PERCENT SLOPES, TIDE FLATS	14.69	0.19%
JAKOLOF SILT LOAM, 0 TO 3 PERCENT SLOPES	40.23	0.53%
JAKOLOF SILT LOAM, 3 TO 8 PERCENT SLOPES	178.03	2.34%
KASITSNA SILT LOAM, 15 TO 25 PERCENT SLOPES, COOL	7.89	0.10%
KASITSNA SILT LOAM, HILLY TO VERY STEEP	37.33	0.49%
KASITSNA SILT LOAM, ROLLING TO STEEP	101.59	1.34%
KASITSNA-KASITSNA,COOL-SELDOVIA COMPLEX, 45 TO 65 PERCENT SLOPES	163.73	2.15%
KASITSNA-NUKA COMPLEX, NEARLY LEVEL TO HILLY	1442.83	18.96%
KASITSNA-NUKA-TUTKA COMPLEX, NEARLY LEVEL TO HILLY	188.05	2.47%
KASITSNA-SELDOVIA COMPLEX, 25 TO 45 PERCENT SLOPES	376.43	4.95%
KASITSNA-SELDOVIA-PORTGRAHAM COMPLEX, HILLY TO VERY STEEP	1112.28	14.62%
KASITSNA-SELDOVIA-PORTGRAHAM COMPLEX, ROLLING TO STEEP	579.55	7.62%
KASITSNA-TUTKA COMPLEX, 45 TO 65 PERCENT SLOPES	737.10	9.69%
KASITSNA-TUTKA COMPLEX, 65 TO 120 PERCENT SLOPES	98.48	1.29%
KASITSNA-TUTKA COMPLEX, HILLY TO VERY STEEP	683.94	8.99%
KASITSNA-TUTKA COMPLEX, ROLLING TO STEEP	457.17	6.01%
KOYUKTOLIK AND NUKA PEATS, 0 TO 8 PERCENT SLOPES	135.69	1.78%
NANWALEK SILT LOAM, 25 TO 65 PERCENT SLOPES	60.58	0.80%
NANWALEK SILT LOAM, 25 TO 65 PERCENT SLOPES, WARM	86.33	1.13%
NANWALEK-KASITSNA, COOL COMPLEX, 25 TO 65 PERCENT SLOPES	329.01	4.32%
NANWALEK-ROCK OUTCROP COMPLEX, 65 TO 120 PERCENT SLOPES	116.52	1.53%
ROCK OUTCROP, SEA CLIFFS	12.72	0.17%
SELDOVIA SILT LOAM, 8 TO 15 PERCENT SLOPES	295.12	3.88%
TALUWIK SILT LOAM, 0 TO 3 PERCENT SLOPES	16.08	0.21%
TALUWIK SILT LOAM, 3 TO 8 PERCENT SLOPES	76.66	1.01%
TUTKA SILT LOAM, HILLY TO VERY STEEP	1.61	0.02%
TYPIC CRYAQUENTS, SALT MARSH	56.84	0.75%
TYPIC CRYAQUENTS-ANDIC CRYOFLUVENTS COMPLEX, 0 TO 3 PERCENT SLOPES	78.01	1.03%
WATER, FRESH	7.83	0.10%
WATER, SALINE	8.49	0.11%
Total	7608.07	

Table 1. Soil Types and Relative Coverage for the Kachemak Bay subunit.

F. *Wildlife Resources*

The Chugach Region is known for its abundant wildlife and marine resources and these resources are heavily relied upon by Native users. Fish and game has been the cornerstone around which the Native lifestyle, religion, social organization and culture developed. The Alaska Traditional Diet Survey conducted in villages throughout Alaska showed that many Native Alaskans derive a large portion of their diet and income from harvesting of subsistence foods (Ballew et al. 2004). Estimates from the Alaska Department of Fish and Game, Division of Subsistence, are that rural Alaskans harvest about 43.7 million pounds (usable weight) of wild food per year or approximately 375 pounds per person per year. While subsistence harvest data has not received detailed study in Port Graham and Nanwalek, data from nearby Seldovia show that in 1993 (Wolfe and Utermohle, 2000) average annual use of wild food per person was ½ lb. per person per day.

The Chugach region is in the path of the North American migration flyway and the principle route of the Pacific flyway. A few common breeding bird species found in the region include bald eagle, Arctic tern, Aleutian tern, mallard, northern pintail, green-winged teal, harlequin duck, sparrows, spruce grouse, willow ptarmigan, rock sandpiper, black-legged kittiwakes, horned and tufted puffins, black oystercatchers, and common murres.

Large wildlife found in the Chugach region includes moose, mountain goat, black bear, and less commonly brown bear. Marine mammals such as humpback whales, harbor seal, sea lions, and sea otter frequent the region. Fur bearing animals such as rabbit, river otter, weasel, mink, fox, lynx, wolverine and muskrat inhabit the forest land. Porcupine and marmot can on occasion be found

The State of Alaska has jurisdiction over resident wildlife regulations on all state and private lands, including Native allotments. The federal government, however, regulates and has jurisdiction over all game and non-game species on federal lands[1] in regards to subsistence. Nevertheless, Native allotment owners can have some influence on wildlife population dynamics through the wise use of their lands.

G. *Fisheries Resources*

The Chugach region provides spawning and rearing habitat for five species of salmon: Pacific (pink), Chinook (king), chum (dog), sockeye (red), and Coho (silver). Salmon usually spend one to five years at sea feeding on a variety of food from plankton to small fish. Adult salmon return

[1] The Alaska National Interest Lands Conservation Act (ANILCA), passed by Congress in 1980, mandates that rural residents of Alaska be given a priority for subsistence uses of fish and wildlife. In 1989, the Alaska Supreme Court ruled that ANILCA's rural priority violated the Alaska Constitution. As a result, the Federal government manages subsistence uses on Federal public lands and waters in Alaska-about 230 million acres or 60 percent of the land within the state. To help carry out the responsibility for subsistence management, the Secretaries of the Interior and Agriculture established the Federal Subsistence Management Program

to the region's streams from late May through September, decreasing in number by October. Other abundant fish include: rainbow trout, Dolly Varden and Arctic char. Fish and wildlife resources in the Chugach region are vital to the subsistence life-style of village residents especially in the Port Graham and Nanwalek area where fish supply over 75% of the total annual subsistence harvest (Kenai Peninsula Borough, 1990). Sockeye and pink salmon are extremely important natural resources in this area and important fish habitat exists along the coastline and inland in the freshwater rivers and lakes.

Unlike other animals and birds, fish are confined to their water bodies, and for anadromous fish, they are committed to returning to their spawning grounds. While many animals can adapt or migrate to other areas when their immediate habitat is altered, fish often cannot find suitable habitat following alterations. Erosion of stream banks, increases in water temperature, increases in water turbidity and siltation, changes in the amount of solar radiation reaching streams, loss of fine and large woody debris, and small changes in channel morphology, streambed stability, nutrient supply, or stream flows can negatively impact fish habitat and subsequent fish populations. In addition, negative impacts on one area of a stream or river can have far reaching consequences on habitat conditions downstream. This is this reason why the Alaska Forest Resource Practices Act (Appendix B), which governs how timber harvesting, reforestation, and timber access occur on state, private, and municipal land, is heavily focused on water quality and fish habitat.

In 1985, sockeye salmon escapement of the English Bay River in the Kachemak Bay subunit was at a low of 5,000 returning adults. Alaska Department of Fish and Game report historic highs of 40,000 returning adult salmon. As a result, the Nanwalek Salmon Enhancement Project was started with the goal of rearing and releasing 1 million salmon fry in the English Bay River system. By the mid 1990's, 34,000 to 44,000 returning adult sockeye salmon were counted. The program is still actively releasing and rearing salmon fry in the English Bay River today.

H. *Timber Resources*

The Chugach region lies at the northern range of Sitka spruce, the primary commercial species in the region. Sitka spruce is a coastal species which is seldom found far from tidewater, where moist maritime air and summer fogs help to maintain humid conditions necessary for growth. The primary disturbances in the Sitka spruce ecosystem are wind, forest pests like spruce bark beetle, and disease. Other species in the region include cottonwood, in riparian areas, as well as non-commercially sized alder and willows. The allotments in the Gulf of Alaska subunit may also include western hemlock and mountain hemlock at higher elevations.

Allotment Forest Inventory

Forest inventory was conducted on the Native allotments within the Kachemak Bay Subunit in October of 2010 and October of 2011. All data was collected with AK_OpTICS v 1.0c beta and compiled with AK_OpTICS v 2.0c beta software which was developed by Thomas E. Burk for

the BIA Alaska Regional Office. A written forest inventory report from the region is currently being prepared from the field data and forms the basis of the timber data presented in this Forest Management Plan. Allotments in the Gulf of Alaska Subunit (Figure 2) have not been visited by timber cruisers so volume and species composition in this unit was estimated using vegetation cover typing from air photos and volume estimates from the Kachemak Bay subunit strata. Future on the ground timber inventory will be required to obtain more accurate information for these allotments and should be conducted as funding becomes available. Strata statistics from the 2011 timber inventory are presented in table 2. Of the cover types identified during vegetation cover typing only cottonwood (CW) and Sitka spruce (SS) cover types contain commercial timber so inventory was limited to these strata. We used an area weighted sampling design to select forest stands to be sampled; with this sampling design larger stands are more likely to be sampled than small stands. As shown in Table 2. Cottonwood (CW) stratum were not sampled; this is because the stratum includes only 11 acres in the region (7,498 acres are in the Sitka spruce (SS) strata) lowering the probability any stands would be selected in our sampling design.

Table 2. Strata sampled during the Chugach Region 2011 forest inventory and associated statistics[2].

Stratum	# of plots	Net BbFt/Acre	Standard Error	Sampling Error
SSS 3	240	25692	770.76	3%
SSS TS 1	20	9863	3649.31	37%
SSS TS 2	50	17481	1748.1	10%
SSS TS 3	40	18300	1647	9%
SSS WM 1	10	437	235.98	54%
Combined	360	23370	701.1	3%

Vegetation Cover Typing

Vegetation cover typing was conducted for allotments in the Chugach Region following the Alaska Regional Office protocols (Wilson, 2005). Individual stands or cover type polygons were delineated and attributed for a cover type. Aids used in the interpretation of timber types on aerial photography include color, texture, hue and physical location of the stand in question. Forested stands were attributed for primary tree species (Table 2); species size class (Table 3), secondary species, and crown density (Table 4). Non-Forested stands were coded for broad cover types including shrub lands, wetlands, and non-forested vegetation cover types.

[2] Abbreviations for strata are Sitka spruce saw timber (SSS), tall shrub (TS), wet meadow (WM), and density classes (1,2, or 3) as defined in table 3,4 and 5.

Table 3. Vegetation Cover Types for the Chugach Region

Vegetation Cover Types			
Forestland			
CODE	Conifers	CODE	Hardwoods
SS	Sitka Spruce	BI	Paper Birch
		CW	Cottonwood
		RA	Red Alder
Shrubland			
DM	Dry Meadow	TS	Tall Shrub
DS	Dwarf Shrub		
Wetlands			
B	Bog	TSw	Tall Shrub wet
DSw	Dwarf Shrub wet	W	Lakes/Ponds
R	River/Flowing Water	WM	Wet Meadow
SW	Intertidal		
Non-forest			
BA	Bare Ground	CURD	Roads/Airstrip
SA	Sand	CUST	Structure

Table 4. Tree species size class for the Chugach Region

Average Size Class		
Type	*Code*	*Size*
Dwarf Forest	D	<25 feet tall
Reproduction	R	1.0 " to 4.4" DBH
Poletimber	P	4.5" to 8.9" DBH
Sawtimber	S	9.0" and greater

Table 5. Stand Crown Density for the Chugach Region

Stand Crown Density		
Type	*Code*	*Percent canopy closure*
Low	1	10% to 40%
Medium	2	40% to 60%
High	3	60% and greater

Cover types that include saw timber, pole timber, and reproduction sized stands are considered to be “timberland” types, with the implication that they are considered productive or have the potential to be productive forestland. Forest lands with a “dwarf” descriptor for size class are considered to be woodland types, which are considered to be unproductive forestland.

Non-forestland is land where the ground surface contains less than 10% tree cover or where trees are absent. Non-forestland is commonly associated with poorly drained soils, high elevation areas, cold summer time temperatures, or human caused development. Non-forestland shrub types can also occur on recently disturbed areas such as burns or flooded areas, and can develop into forestland over time. Non-forest cover types include shrub land types, wetland types, water bodies, barren areas, cultural areas, etc. If a non-forest cover type was a major component of a forested stand (> 30%), it was combined with the forest type in the cover type, similar to the way a secondary tree species could be combined with a primary tree species.

Aerial Photography and Imagery

The vegetation cover typing described above was conducted using aerial photography and satellite imagery from various sources and dates. The allotments in the Kachemak Bay Subunit were flown by Chugachmiut for color air photography in 2003. 2008 satellite imagery from the Kenai Peninsula borough near Seward and older US Forest Service photography from Valdez were used for the allotments near Seward and Valdez. All other Gulf of Alaska Subunit images were provided BIA and flown in 2004.

Forestland Description

The dominant tree species in the region is Sitka spruce (*Picea stichensis*). Sitka spruce is Alaska's largest most valuable tree and the state tree. Sitka spruce is typically found from sea level to 1500ft in elevation and can be found as high as 3000ft in elevation. Sitka spruce is moderate in shade tolerance but does well in full sun. Sitka spruce in the Kachemak Bay subunit is found in pure stands and may be in pure stands or mixed stands with western hemlock (*Tsuga heterophylla*) in the Gulf of Alaska subunit. Western hemlock does not grow as fast as Sitka spruce and is considered shade tolerant.

The dominant forest hardwood tree species in the region is cottonwood (*Populus tricocarpa*). The cottonwood type is generally found along larger stream in valley bottoms. These sites usually are quite productive. Cottonwood stands develop as a successional sequence that begins with alder-willow thickets on exposed sandbars and eventually develops into Sitka spruce forest. Cottonwood trees also produce large quantities of seed that can spread over long distances. Although paper birch could grow in the region inventory and remote sensing data has not identified any birch in the region.

Timberland types include sawtimber, poletimber and reproduction sized stands. Woodlands, such as dwarf Sitka spruce are also identified. Delineation of woodlands is based on tree species together with a dwarf descriptor. Woodlands are considered unproductive forestland, in contrast to timberlands that are considered productive or have the potential to be productive forestland.

Non-Forestland Description

Non-forestland is land that contains less than 10% tree cover. Non-forestland is commonly associated with poorly drained soils, high elevation areas, cold summer time temperatures, or human caused development. Non-forestland shrub types can also occur on recently disturbed areas such as burns or flooded areas, and can develop into forestland over time.

Non-forest vegetation types delineated from the aerial photography include tall shrub such as willow and alder, wetlands, lakes and rivers, and barren areas. Cultural features such as roads, villages and cabin sites were also identified and included as non-forest. Figure 4, table 6, and table 7 show acreage of forested and non-forested land in the Chugach Region and by subunit.

Land Classification and Forest Volume

Chugach region contains 9,039 acres of Native allotments of which 7,771 acres are forested (Table 5). Forestland is further broken down into categories of accessible areas, timberland, woodland, commercial, and non-commercial areas. Total net volume of forestland is 176,227 thousand board foot (MBF) with an additional 26,036 hundred cubic feet (CCF) in trees two inches diameter at breast height (DBH) and greater. Board foot volumes are for trees 9 inches and larger using the Scribner board foot rules. If timber in the region was only used for biomass, the region contains 602,525 bone dry tones of biomass. Table 7 shows available forest volume by subunit. The Gulf of Alaska Subunit had no inventory data collected. Before forest operations are planned in the subunit ground based forest inventory should be conducted. It is also important to consider that forest inventory was conducted in 2010 and 2011 but forests are constantly changing; as this plan ages forest inventory will need to be periodically conducted.

Table 6. Acreage and timber volume by land classification.

Allotment Acreage in the Chugach Region: 9,039 acres

Forest: *7,771 acres; 176,227 MBF and 26,036 CCF; or 602,525 BDT*
- Accessible: *7,771 acres; 176,227 MBF and 26,036 CCF; or 602,525 BDT*
  - Timberland: *7,601 acres; 176,190 MBF and 25,992 CCF; or 602,525 BDT*
    - Commercial: *7,601 acres; 176,190 MBF and 25,992 CCF; or 602,525 BDT*
  - Woodland: *170 acres; 37 MBF and 37 CCF; or 341 BDT*
    - Commercial: *99 acres; 37 MBF and 44 CCF; or 341 BDT*
    - Non-commercial: *71 acres; 0 MBF and 0 CCF; or 0 BDT*

Non-forest: *1,268 acres; 0 CCF; 0 MBF*
- Accessible: *1,268; 0 CCF; 0 MBF*
  - Barren and cultural: *132 acres; 0 CCF; 0 MBF*
  - Rivers and lakes: *104 acres; 0 CCF; 0 MBF*
  - Shrubland: *755 acres; 0 CCF; 0 MBF*
  - Wetland: *278 acres; 0 CCF; 0 MBF*

Through database and GIS compilations all allotment parcels that were vegetation typed were sorted to classify the land. The various land classifications are described below:

1. **Forest or forest land**: An ecosystem at least one acre in size, including timberland and woodland, which: is characterized by a more or less dense and extensive tree cover; contains, or once contained, at least ten percent crown cover, and is not developed or planned for exclusive non-forest resource use.
2. **Non-forest land**: Land that has never supported forest growth, and land formerly forested, where forest management is precluded by development for other uses such as cropland, improved pasture, residential areas, parks, improved roads, power-line clearings, and areas of water 1 acre or larger. If intermingled in forest areas, unimproved roads and non-forest strips must be more than 120' wide and more than 1 acre in area to qualify as non-forest
3. **Reserved forest land**: Forest land that has been administratively withdrawn from harvest for environmental, political, wildlife, archeological, or other reasons.
4. **Unreserved forest land**: Forest land that is administratively available for harvest
5. **Accessible forest land:** Forest land that is physically, administratively and economically accessible to harvest or is anticipated to become so during the management plan period.
6. **Inaccessible forest land:** Forest land where access is not practical due to administrative, topographic, or economic criteria. Accessibility is a local determination and should reflect forest type mapping and regional forest management policies. On allotted lands in Alaska,

inaccessible forest land is forest land that is located further than one mile of navigable water source or is greater than 5 miles from a road.

7. **Timberland:** Forest land stocked, or capable of being stocked, with tree species that are regionally utilized for lumber, pulpwood, poles, or veneer products.
8. **Woodland:** Forest land not included within the timberland classification, stocked, or capable of being stocked, with tree species of such form and size to produce forest products that are generally marketable within the region for products other than lumber, pulpwood, or veneer.
9. **Commercial forestland:** Forest land that is producing or capable of producing crops of marketable forest products and is administratively available for intensive management and sustained production.
10. **Commercial woodland:** Land qualifying as forest, containing less than 5 percent commercial timber species crown cover, diameters at least 3.0" at root collar (DRC) of woodland species or 5.0" DBH of timber species, and considered of high site potential capable of growing at least 5 cu. ft/ac/yr of merchantable material. It is a term coined to describe that portion of woodland producing marketable woody products, which is currently or prospectively accessible, is not withdrawn from such use, and not already accounted for within commercial or noncommercial timberland..
11. **Non-commercial forestland:** Forest land that is available for extensive management, but is incapable of producing sustainable forest products within the general rotation period. Such land may be economically harvested, but the site quality does not warrant significant investment to enhance future crops.
12. **Non-commercial woodland:** Woodland that is available for extensive management, but is incapable of producing sustainable forest products within the general rotation period. Such land may be economically harvested, but the site quality does not warrant significant investment to enhance future crops.
13. **Productive forestland:** Forest land producing or capable of producing marketable forest products that is unavailable for harvest because of administrative restrictions or because access is not practical.
14. **Unproductive forest land:** Forest land that is not producing or capable of producing marketable forest products and is also unavailable for harvest because of administrative restrictions or because access is not practical.

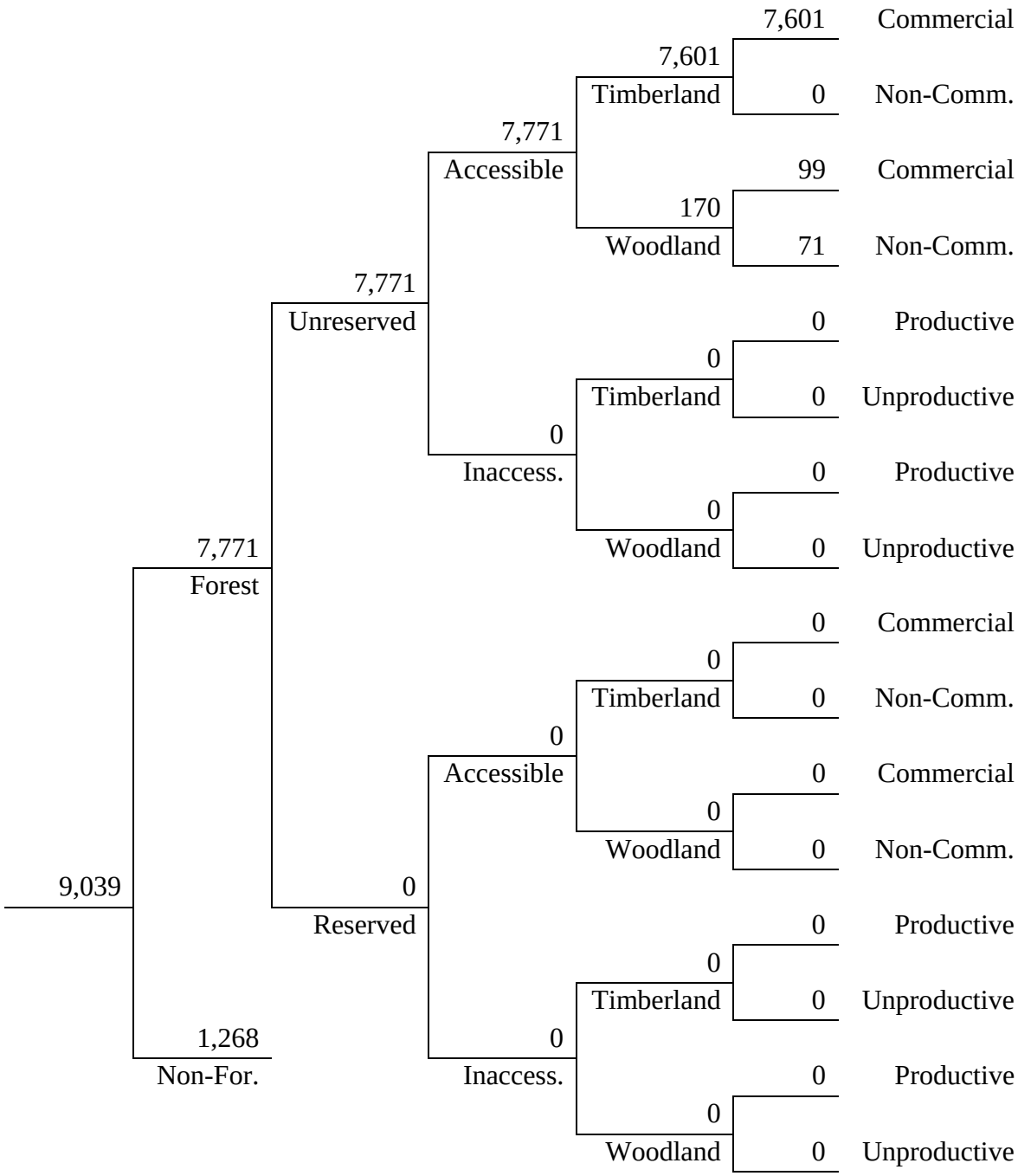

Figure 4. Bureau of Indian Affairs land classification chart.

Table 7. Timber volume summary for subunits.

Cover Type Classes	Acres	MBF	and CCF	or BDT
Gulf of Alaska Subunit				
Bare ground	11	0	0	0
Brush	194	0	0	0
Cottonwood	5	0	0	0
Dry Meadow	55	0	0	0
lake/pond	79	0	0	0
River	0	0	0	0
Sand	114	0	0	0
Sitka Spruce	1,114	23,911	347,330	82,000
Tall Shrub	115	0	0	0
Village	3	0	0	0
Wet meadow	59	0	0	0
Gulf of Alaska total:	1,750	23,911	347,330	82,000
Kachemak Bay Subunit				
Cottonwood	6	0	0	0
Dry Meadow	2	0	0	0
Intertidal	38	0	0	0
lake/pond	19	0	0	0
River	6	0	0	0
Sand	4	0	0	0
Sitka Spruce	6,638	152,316	2,256,302	520,866
Tall Shrub	420	0	0	0
Village	1	0	0	0
Wet meadow	156	0	0	0
Kachemak Bay total:	7,289	152,316	2,256,302	520,866
Grand Total:	9,039	176,227	2,603,632	602,866

Forest Productivity

Forest Productivity is generally lower in the Chugach Region for Sitka spruce than southeast Alaska where growing conditions are more favorable. Evaluating productivity in a broad sense, however, can be related to tangible and intangible products and values derived from these forests as well as individual tree growth characteristics (Zasada et. al. 1997). Allotment forest resources may be considered productive to the residents regardless of tree size, structure, composition and extent. Conditions important to tourism, spiritual values, aesthetics and ecosystem function may also be difficult to quantify with traditional measures of forest productivity.

When looking at a measurable means of estimating productivity of timber stands, tree height has been found to be a reliable indicator. Tree height can be related to tree age and expressed in terms of site index. The site index number gives the height in feet of a particular tree or stand (averages of measured site trees) at a reference base age. In southeast Alaska, site index formulas for Sitka spruce generally use a base age of 50 years (Farr 1984). Using the Farr 1984 equations the site index average for the Kachemak bay subunit is 61 with the most productive stand at site index 76 and least productive at 39. Inventory was not collected for any of the Gulf of Alaska subunit allotments and site index was not measured.

Annual Allowable Cut

Annual allowable cut (AAC), or annual allowable harvest, is an estimate of the average volume of timber that may be harvested annually over an area or an ownership such that the long term yield of timber does not decline. A number of elements should be considered in the calculation of AAC, not all of which may be well known, including current stock, growth rates, mortality, productive area, and rotation lengths. Because of the difficulty in applying the concept of an annual allowable cut to a large number of relatively small parcels, owners, and varying management objectives, AAC was not determined for the Chugach Region Allotment Forest Inventory. The consideration of individual allottee goals and the proposed actions driven by those goals make it difficult to consider AAC when evaluating a single action or allotment parcel. However, it may be useful to consider the concept of maximum allowable harvest levels allowed within a region, subregion, or some other geographic area, especially when considering the cumulative impacts of multiple activities. AAC was not calculated as part of this plan.

If a forest manager desires to calculate AAC for this region or a subunit; calculations can be based on the simple area cut method. The area cut method simply divides the total productive forest area by rotation age, giving the acreage that can be harvested in a year. This acreage is then multiplied by the weighted average of forest volume per acre to determine the AAC. For the Chugach region a rotation age of 60 to100 years is reasonable. A possible AAC using the area cut method assuming a 100 year rotation age is 1,747.8 MBF/year

Wildland Fire

The coastal forest zone of the Chugach Region with its climatic features of cool temperatures, high humidity and abundant rainfall, rarely experiences periods of high fire danger. Lightning fire occurrences are virtually non-existent. Since 1939 there have been 90 total reported fires (Figure 5), only 3 caused by lighting, 82 human caused, and 5 of unknown origins; a total of 316.4 acres have burned (Alaska Fire Service 2010). However, running surface fires in slash or dried shrubs and grasses can be experienced during periods of low humidity when these fine fuels dry out very rapidly. The potential for major fires then exists with as little as a week of no rain coupled with warm windy conditions. These conditions can develop during the short

summer season in July and August. Fire starts are most common along the road system in Seward, Valdez, and Cordova.

A current region-wide programmatic Native allotment fire management plan exists that provides much detail and information related to wildland fire management on Native allotments, potential fuels management activities, suppression options, relationships with fire suppression agencies, and more (Chugachmiut, 2001).

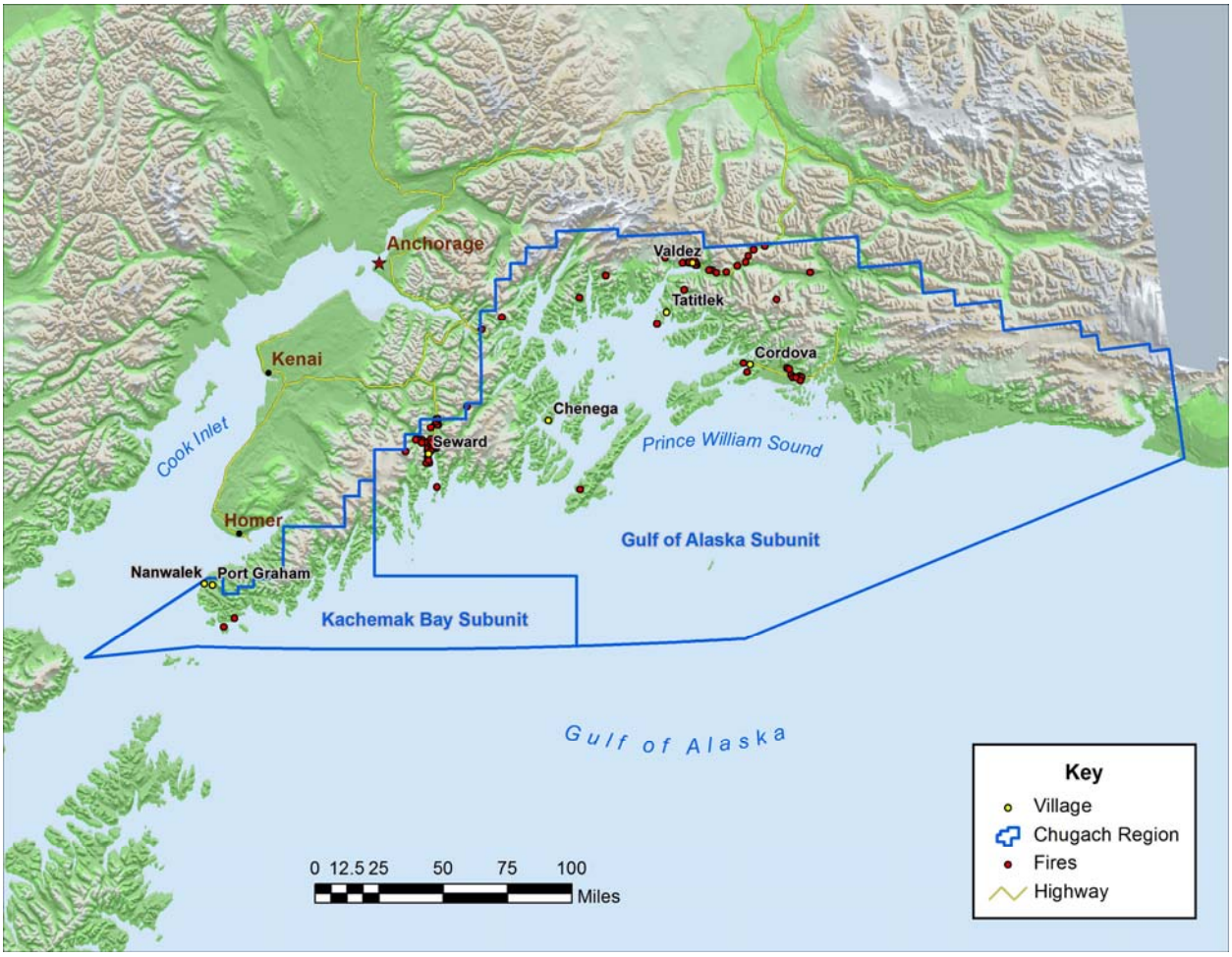

Figure 5. Fire History of the Chugach Region: 90 wildland fires have been reported (1939-present.)

V. Forest Management Practices

A. *Silvicultural Systems*

Silviculture is defined as the art and science of tending a forest by controlling forest establishment, composition and growth. Returns from silviculture are generally thought of in terms of timber production. However, with increased emphasis on integrated resource management, it is not uncommon for the land owner to have goals other than timber production such as wildlife habitat enhancement, watershed restoration, forest botanicals, or hazard fuel reduction. The essential requirement therefore, is to define objectives with targeted outcomes and then design treatments shaped to their attainment.

Silviculture treatments should apply to the total cycle of forest development (at least one rotation). When deciding on a particular system, the forest biology of the tree species being managed needs to be considered as well as the economics of the various treatments in question. Different species of trees need different methods of harvest for optimum regrowth and economic return. Species like Sitka spruce prefer openings for optimum regeneration and regrowth. Even-aged treatments such as clearcut harvesting take advantage of this preference and allow young spruce trees the opportunity to thrive. However, Sitka spruce forests in climax stages tend to have many small gaps of 1-3 trees (Nowacki and Kramer 1998). Other research shows that small group selection, individual tree selection, or other uneven aged silvicultural systems can be successfully implemented on appropriate sites (Deal et. al., 2002; Deal et al, 2007). Management objective such to promote subsistence resources like blueberries may require the use of uneven aged silvicultural systems in this region.

B. *Identification of Commercially Viable Timber Stands*

Although the current demand for forest products in the region is relatively low, historical demand has been high. During the 1970's – 1990's, Regional and Village ANSCA corporations successfully operated commercial timber operations in the area. Some Native allotment owners were able to sell commercial timber in coordination with larger sales on ANSCA corporation lands. Currently, demand for forest products is primarily driven by local use. Developing bio-energy projects in the region could offer the opportunity for more active forest management to occur on Native allotments in the future but until current timber markets change it is not likely to see commercial timber operations like those during the 1970's to 1990's.

A subset of allotments containing commercial timber stands has been identified to guide future management activities. This subset is comprised of allotments that are within the commercial timberland designation and contain at least 50,000 board feet of spruce timber. It is expected that timber volumes of this nature may provide timber for home construction, fuel use, or commercial timber sale opportunities. These allotments may also prove as suitable candidates

for forest development activities such as tree thinning. The Kachemak Bay subunit comprises the majority of these allotments and potential commercially viable parcels in this subset include almost 152.3 million board feet of timber (Table 7). The Gulf of Alaska subunit parcels in this subset totaled 23.9 million board feet of timber (Table 7).

C. ***Mature High Risk Timber Stands***

Mature high risk timber stands are those stands that are deemed valuable and that are particularly susceptible to loss due to animals, insects, disease, fire, flooding, stream bank erosion or property development. Many of the high risk stands are situated on the potential commercially viable allotments. In the Chugach Region mature high risk timber stands consist of Sitka spruce of density class 2 and 3. The primary threats to mature timber stands in the region are bark beetle and wind storms.

In costal Sitka Spruce forests wind driven disturbance events such as windthrow or windsnap are major forms of forest disturbance (Harris 1989, Nowacki and Kramer 1998). These disturbances can occur at large scales as stand replacing events or small scales killing as few as one tree. Small scale wind disturbance typically work in conjunction with wood decay in forests and are generally more common in older forests where heart rot, fungal infections, and decay are more prevalent. Generally, large scale wind driven disturbance is found on exposed windward areas while sheltered leeward locations receive more small scale wind disturbance.

Conditions Conducive to Spruce Bark Beetle Infestations

- Warm, dry summers puts stress on spruce trees and makes them more susceptible to attack from spruce bark beetles. Drought conditions may invite beetle infestations. Colder wet springs and summers will actually slow bark beetle progression. Trees are generally healthier with more moisture and, therefore, more resistant to attack.
- Spruce bark beetles generally attack mature, older, injured or fallen spruce trees. These trees produce significantly less resin than healthy trees which are able to repel many of the initial beetles trying to enter and establish galleries. Green, older trees that have recently fallen are the most susceptible to attack.
- Old dead trees are not attacked by beetles.

Signs of Beetle Infestation

- Signs of spruce bark beetles include small holes or mounds of saw dust on the tree and tree base. A small section of bark from an area near the bore holes can be pulled off to expose the inner layer of the bark. Tunneling pathways in this layer is evidence of infestation.
- Reddening of the spruce needles is evidence that the tree is being killed by something. Examining the tree as detailed above can help determine the cause.

Methods to Avoid Infestations

- Spruce bark beetles generally don't feed on young trees. To improve the overall health of stands, thinning can be performed to increase residual tree vigor and remove some of the older, large diameter spruce trees that are most susceptible to attack but care must be taken as thinning Sitka spruce can lead to blowdown in the future.
- Adult spruce bark beetles over-winter under the bark at the tree base. This area is generally in the root flare of the tree below ground level. When cutting down infested trees, cut as low as possible to the ground to remove potential breeding sites.
- Spruce bark beetles can feed on downed spruce trees for 2 years before the moisture content becomes too low. Infested material should be cut into 4 foot lengths or less, split and cross stacked in the sun to dry. Partially de-barking the larger pieces will hasten drying.
- Spruce bark beetles cannot feed on dried spruce trees. Removing the bark or drying the wood will destroy the eggs laid underneath.
- In the case of beetle infestations trap trees can be utilized. A trap tree consists of a large tree or group of trees which are felled or girdled before beetles emerge from the bark in the spring. These trees attract flying beetle that lay eggs in the trap trees. Trap trees are than destroyed before beetle larva emerges in the spring of the next season.

VI. Issues, Concerns and Opportunities

Issues, concerns and opportunities are identified to guide the decision-making process engaged by a land manager when evaluating a proposed forest or fire management activity. They have been compiled from responses to mailings, interdisciplinary scoping, and reports by subject matter experts.

A. Air Quality

- There is a lack of localized data of air quality for the Chugach Region.
- Prescribed fire and wildfire activity can reduce air quality for short periods of time; currently fire activity in the region is limited.
- Increased fire activity due to global climate change may affect future air quality.
- Increased use of woody biomass as an energy source could have negative impacts on air quality.
- Alaska Department of Environmental Conservation (ADEC) has responsibilities for air quality on both State and Federal lands in Alaska.

B. Cultural Resources

- Protection of all historic and archaeological sites on and off trust lands is both required by law and important for the preservation of local Native culture.
- Identification and cataloging of cultural sites including existing improvements on Native allotments is incomplete.
- Maintaining confidentiality of cultural resources and their locations is important for their protection and maintenance of cultural value.
- Any proposed action requires compliance with Section 106 of the National Historic Preservation Act of 1966 and other pertinent legislation.
- Sale of Native allotments to non-Natives results in loss of control and access to the cultural resources of local Native communities.

C. Water Resources

- Protection of rivers, streams and lakes is important for a variety of resource values.
- Aesthetic qualities of the overall landscape have been recognized and should be maintained.
- The potential of sedimentation of water bodies from soil erosion as a result of disturbances including forestry operations, road building, prescribed burning, and wildfires could impact water quality and fish habitat.
- Identification and cataloging of anadromous and high value resident fish water bodies could be improved and made more comprehensive.
- Retention and recruitment of both fine and large woody debris along and within important water resources serves to protect streambed and bank stability, maintain water temperature, minimize sedimentation, maintain nutrient supply, and maintain holding water for fisheries.

D. Soil Resources

- Detailed soil survey has been completed for the Kachemak Bay subunit but areas in the Gulf of Alaska subunit do not have detailed soil surveys.
- Seasonal flooding in active floodplains may cause erosion and loss of soil should soil structure and integrity be jeopardized through forest operations.
- Massive soil erosion on steep slopes may occur after timber harvest, road building, heavy precipitation, or forest fires.

E. Wildlife Resources

- There is great dependence by locals on wildlife resources for subsistence purposes.
- Maintaining and improving wildlife use of the area is desirable.
- Changes in ungulate populations.
- Effects of forest harvesting, implementation of silvicultural prescriptions, hazard fuel reduction and/or use of wildland fires for resource benefits on fish and wildlife habitat.

- Maintenance or addition of components necessary for productive wildlife populations and habitats such as cover, forage and snags.
- Compared to interior Alaska, there are relatively few opportunities for large disturbances (fire, flooding) across the landscape allowing for the development of early seral species such as willow, birch, and aspen.
- Wildlife habitat can be enhanced by designing silvicultural treatments to replicate natural disturbance effects on the landscape while also increasing forest productivity.
- Sale of Native allotments to non-Natives remove land from trust status and control of management is lost.

F. Fisheries Resources

- There is great dependence by locals on fisheries resources for subsistence purposes.
- Maintenance of restored salmon runs on the English Bay River system, the Port Graham area, and anadromous streams throughout the Chugach Management Unit is important.
- There is increasing competition for fish resources among subsistence, commercial and sport fisherman.
- Forest and fire management activities, including forest harvesting, the implementation of silvicultural prescriptions, hazard fuel reduction and/or use of wildland fires for resource benefits can have positive and negative impacts on fish and wildlife habitat. Maintenance of environmental components necessary for productive fish habitats and population such as clean water, riparian buffers and availability of fine and large woody debris is critical.
- Sale of Native allotments to non-Natives remove lands from trust status. Use and control of management is lost.

G. Timber Resources

- There can be opportunities for allotment owners to benefit monetarily from the sale of their timber resources.
- Management activities can result in improved access resulting from forest development and forest management practices.
- Unauthorized access and trespass can occur on the allotments.
- Conifer growth and stocking of commercial timberland can be improved through active management.
- Hazard fuel reduction projects and forest development activities such as thinning, can reduce fire risk to allotment structures and improve timber stand quality and condition.
- Forest management can result in production of sawtimber and houselog quality logs.
- Outbreaks of insects and disease can affect forest health and productivity.
- Forest management can result in maintaining and/or improving the health of the residual forest and reestablishing a well-stocked free to grow stand after harvest

- Uncontrolled wildfire can result in loss of timber and property.
- Adequate regeneration of Sitka spruce following timber harvest activities can be difficult to achieve.
- Access development and effects on human use of the area can result from forest management activities.
- Land management activities can affect the allotment owner's enjoyment of visiting their allotment and existing use patterns.
- Wildlife habitat can be enhanced by designing silvicultural treatments to replicate natural disturbance's effects on the landscape while also increasing forest productivity.
- Climate change may affect growth rates and survival of tree species and their resilience to forest pests.
- Sale of Native allotments to non-Natives remove trust lands from use and control of management.

H. Fire and Fuels

- Unnecessary loss of property can result from wildfire.
- Fires can have negative effects on air quality.
- Natural and prescribed fire can positively and negatively affect silvicultural and wildlife enhancement goals.
- Fire and other fuels treatments can be used as a tool to decrease the risk of catastrophic fire.
- Wildfire and prescribed fire contribute or can be used to attain silvicultural and wildlife enhancement goals.
- There are high costs associated with hazardous fuel reduction operations on Native allotments with limited funding sources.
- It is necessary to determine and document allotment owners' goals and objectives for fire management purposes.

I. Social and Economic Resources

- The local economy is highly dependent on natural resource-based industry.
- Local unemployment is highly volatile due to the seasonal nature of the fishing industry.
- The primary market for Chugach Region timber is Asia, and in today's current markets timber sales designed for export are generally uneconomical.
- Native owners should time proposed timber harvest operations to coincide with adjacent Native Corporation timber sales to attract more interest from timber sale buyers.
- A small scale local use market could be developed for forest products such as biomass, house logs, and rough sawn lumber.

VII. Goals and Objectives

Goals describe future expected outcomes and provide programmatic direction. They focus on ends rather than means. Objectives are clear, realistic, specific, and measurable statements of action which, when completed, will move towards goal achievement. Objectives tell how to meet a goal. Each allotment owner throughout the Chugach Management Unit will have different goals and objectives for their individual allotment. Some allotment parcels are owned by a number of owners, often descendants of the original owner, and each owner frequently has their own goals and objectives for the land and its resources. Some allotment owners want to actively manage their forest resources while others prefer a hands-off approach. As a service provider, it is the mission of Chugachmiut to help owners identify their goals and then to help them prioritize and accomplish them. While managing allotments on a parcel by parcel basis, a landscape approach of forest management is required to ensure that these underlying responsibilities are met. It is important to remember that the scope of this document includes the implications of forest management actions, and does not include the consideration of actions that are directed primarily or solely at the management of other resources. That being said, it is recognized that forest management actions have positive and negative direct and indirect effects on the environment and other resources.

The *State of Alaska Forest Resources Protection Act* (FRPA) and the Best Management Practices (BMPs) produced to aid in implementation of the Act, provides a useful resource when trying to select practices or applications that would mitigate potential negative effects of forest management practices on other resource values. The FRPA is not authorized to apply to restricted allotted trust lands, but voluntary application of the regulations and BMPs is a useful approach when attempting to select management practices appropriate for meeting various resource management goals. The FRPA applies standards and regulations by several different regions in Alaska; the Chugach Management Unit is in Region I as defined by FRPA. Selected FRPA BMP's are presented in Appendix B by resource and category, and referenced in the following discussions of resource goals and objectives.

The following are landscape level goals and objectives by resource to be considered while managing allotments throughout the Chugach Management Unit:

A. ***Air Quality***

Goals:

- Maintain exceptional air quality and visibility currently found throughout the entire area.

Objectives:

- Limit pile burning and prescribed fire to when winds are favorable for fire control and smoke management.
- Give careful consideration to the anticipated smoke impacts produced under the various burn scenarios.
- Obtain written approval from the Alaska Department of Environmental Conservation (ADEC) before any prescribed fire is ignited.

B. ***Cultural Resources***

Goals:

- Protection of cultural, historic, and archaeological sites and artifacts on and off trust lands.
- Avoid adverse effects to historic sites and traditional places.

Objectives:

- Conduct archaeological review and on-site inspection with trained personnel prior to any and all ground disturbance activities as required under Section 106 of the National Historic Preservation Act of 1966.
- Conduct other reviews and compliance measures required under other legislative authorities including the *Native American Graves Protection and Repatriation Act* (NAGPRA), the American Indian Religious Freedom Act (AIRF), and the *Archaeological Resources Protection Act* (ARPA).
- Help allotment owners generate income from the sale of forest products from their parcel to help avoid the need to sell their allotment for financial relief resulting in the loss cultural sites.

C. ***Water Resources***

Goals:

- Protect rivers, streams and lakes and preserve pristine water quality currently found throughout the region.
- Protect aesthetic qualities of the overall landscape.
- Prevent sedimentation of water bodies from soil erosion resulting from management activities and wildfires.
- Retain and recruit fine and large woody debris along and within important water resources to protect streambed and bank stability, maintain water temperature, minimize sedimentation, maintain nutrient supply, and maintain holding water for fisheries.

Objectives:

- Incorporate State of Alaska, Forest Resources & Practices regulations and riparian standards for Region I for all forest management activities and forest road building. Incorporate no-cut buffers immediately adjacent to anadromous or high-value resident fish water bodies.
- Re-vegetate steep slope areas abutting surface waters with native plant stock after fires natural disturbance and/ or forest management operations in order to prevent erosion, mass wasting and sedimentation of water resources.
- Implement Best Management Practices (BMP's) from the Alaska Forest Resources Practices Act (See Appendix B) for all forest operations including timber harvest, silvicultural treatments and road construction.

D. ***Soil Resources***

Goals:

- Maintain or improve soil structure, integrity and productivity.
- Prevent soil erosion resulting from forest and fire management operations and, when feasible, from natural events such as wildfire.

Objectives:

- Choose silvicultural and harvesting systems that allow the maximum amount of sunlight to reach the forest floor to maintain soil temperature and productivity while still achieving the desired forest management and fire management goals
- Implement Best Management Practices extracted and interpreted from the Alaska Forest Resources Practices Act (Appendix B) for all forest operations including harvest, silvicultural treatments and road construction as they relate to soil resources.
- Re-vegetate steep slopes that have burned from wildfire with native vegetation or trees.
- Replant harvested areas with local seed stock if natural regeneration is insufficient.

E. ***Wildlife Resources***

Goals:

- Improve and protect important wildlife habitat.
- Protect Native allotments from trespass by guides, outfitters, hunters and fishermen.

Objectives:

- Pursuant to Section 7 of the Endangered Species Act, request a list of threatened or endangered species and designated critical habitats prior to beginning any significant forestry or fire management project on Native allotments.

- Favor selection of silvicultural systems that enhance early successional habitat suitable for browse by moose when conducting timber harvesting operations.
- Identify and spatially locate with use of a GPS receiver critical habitat areas in and near allotment parcels. Bald eagle nests, bear dens, salmon spawning beds, etc. are some examples of important sites that should be located when encountered in the field by personnel regardless of their discipline. This information and associated attribute data can then be archived in a GIS system to be used by all resource managers.
- When risk of erosion is low and it is economically feasible, mechanical scarification of soils can be used to expose bare mineral soil while conducting forest management activities. This will help with the regeneration of most woody species. It also provides planting sites for Sitka spruce. Blade scarification (by a dozer or skidder) or pulling a disk trencher is the most common methods of mechanical scarification. Whole tree skidding can result in adequate scarification on some sites. A disk trencher pulled behind a dozer provides continuous uniform scarification unless logging slash or debris is large or dense enough to hinder effective penetration by the disks. Blade scarification can be done on sites where logging debris or blow-down would hinder disk trenching, but it requires operator experience to avoid scalping away too much of the organic layer (which retains moisture on dry sites and provides nutrients for seedlings over time).
- Retain live trees, snags, and woody debris that provide vertical structure, denning sites, and cover for wildlife when conducting harvest operations or silvicultural treatments. Cavity trees, whether they are dead or alive, will be retained when possible. Trees with broken tops often develop heartwood rot while still alive and become hollow, often without cavity openings on the bole. These types of trees have marginal economic value as fuel wood and will be left standing if they do not pose a safety risk during operations. If choices are necessary, larger cavity trees are relatively more valuable to wildlife than smaller cavity trees, all other factors being equal. Hard snags (those with solid sapwood) are often windfirm, may have value as lumber and fuel wood, and also provide important habitat to various birds and animals. Even in sale units where fuel wood salvage is the main objective, some snags will remain across the stand to provide well-distributed habitat as the new crop of trees regenerates. Woody debris (stumps, root wads, and blow-down) will be left in place unless it poses a safety risk or moving it is approved by the forester-in-charge to enhance operation efficiency during harvest or site preparation.
- In timber harvest units, prevent entry by machinery into patches of healthy advanced regeneration with few marketable trees. Patch retention within a sale functions to protect future crop trees as well as animal dens, seed trees, or other features of value as habitat.
- Post Native allotments parcels as private property, especially those along major river corridors that are heavily used, to avoid trespass by guides, outfitters, hunters and fishermen.

F. ***Fisheries Resources***

Goals:

- Protect important anadromous and high value resident fish spawning and rearing habitat.
- Protect rivers, streams and lakes and preserve pristine water quality currently found throughout the area.
- Prevent sedimentation of water bodies from soil erosion after forest fires.
- Retain and recruit fine and large woody debris along and within important water resources to protect streambed and bank stability, maintain water temperature, minimize sedimentation, maintain nutrient supply, and maintain holding water for fish species.
- Protect Native allotments from trespass by guides, outfitters, hunters and fishermen.

Objectives:

- The regulations and Best Management Practices (BMPs) of the State of Alaska Forest Resources and Practices Act (FRPA) that relate to water quality and fish habitat provide useful standards when determining appropriate forest practices. In addition, the following standards for Region I in the FRPA as they relate to riparian management can be used as management objectives applied to water resources and fish habitat:
  - Along a Type A water body, timber harvest may not be undertaken within 66 feet of the water body. A "Type A water body" means an anadromous water body that is 1) a stream or river of any size having an average gradient of eight percent or less, with banks held in place by vegetation, channels that are not incised, and a substrate composed of rubble, gravel, sand, or silt; 2) wetlands and lakes, including their outlets; and 3) and estuarine area delimited by the presence of salt-tolerant vegetation.
  - Along a Type B water body, timber harvest may not be undertaken within 66 feet of the water body or to the break of the slope, whichever area is smaller. A "Type B water body" means an anadromous water body that does not meet the definition of a Type A water body.
  - Along a Type C water body, the timber operator shall, where prudent, retain low value timber within 25 feet of the stream where the width of the water body is greater than 13 feet at ordinary high water or greater than eight feet at ordinary high water if the channel is incised. A "Type C water body" means a water body that is not anadromous, that is a tributary to a Type A or Type B water body, and that has a gradient of 12 percent or less.
  - Along a Type D water body, the timber operator shall, where prudent, retain low value timber within 25 feet of the stream where the width of the water body is greater than 13 feet at ordinary high water or greater than eight feet at ordinary high water if the channel is incised. A "Type D water body" means a water body that is not anadromous, that is tributary to a Type A or Type B water body, and that has a gradient greater than 12 percent.
- Re-vegetate steep slope areas abutting surface waters with native plant stock after fires and/ or forest management operations in order to prevent erosion, mass wasting and sedimentation of water resources.
- Post Native allotments parcels as private property, especially those along major river corridors that are heavily used, to avoid trespass by guides, outfitters, hunters and fishermen.

- Help allotment owners generate income from the sale of forest products from their parcel, to reduce the need or desire to sell their allotment parcel for financial gain.

G. ***Timber Resources***

Goals:

- Prevent unauthorized use and timber trespass on Native allotments
- Help allotment owners generate income from the sale of forest products from their allotment.
- Produce high quality sawtimber and houselogs from forested Native allotments.
- Manage forest resources on a sustained-yield basis.
- Monitor insects and disease within the forest ecosystem and be prepared for changes in endemic populations.
- Maintain and/or improve the health of the residual forest.
- Re-establish well-stocked, free to grow timber stands within five years after harvest.
- Prevent loss of timber and property from uncontrolled wildfire.
- Manage forest resources in ways that maintain and improve wildlife habitat and do not harm fisheries resources.
- Manage allotments under the goals and objectives of the allotment owner while protecting the trust resource for future generations.

Objectives:

- Maintain and periodically update forest inventory data and Geographic Information System.
- Post Native allotments as private property to prevent timber trespass and theft.
- Identify local forest product needs within the Chugach Management Unit.
- Develop feasibility standards for selling and harvesting timber. Identify, spatially locate, and rank mature timber stands that have forest harvesting potential and solicit interest from prospective buyers and sellers (Native allotment owners).
- Identify, spatially locate, and rank timber stands that have forest development potential. Research and identify appropriate silvicultural standards for planting, stocking, thinning, and pruning of targeted commercial tree species. Develop cost-benefit analysis protocol to be done on each forest development project.
- Identify, spatially locate, and rank productive timber stands most threatened by wildfire and develop methods to prevent loss of timber and property from uncontrolled wildfire.
- Maintaining and encouraging deciduous trees or shrubs on specific sites as discussed under objectives for wildlife resources, is one management tool that can help reduce the risk of wildland fire spreading onto allotments.
- Incorporate State of Alaska, Forest Resources & Practices Regulations for Region I for all forest management activities and forest road building. Accept the same riparian standards required on public lands in Region I.

- Implement Best Management Practices (BMP's) from the Alaska Forest Resources Practices Act (See Appendix B) for all forest operations including harvest, silvicultural treatments and road construction.
- When natural regeneration is insufficient, replant harvest areas with seed collected in the same seed zone and general locale as the harvested area.
- Annually evaluate insect surveys done in the region by the State of Alaska and U.S. Forest Service (USFS) in order to ascertain changing insect population dynamics and possible threats to forest resources. Consult and/or request surveys by the State and USFS as needed.
- Implement objectives stated above under Wildlife and Fisheries Resources that maintain and improve wildlife habitat and do not harm fisheries resources.

VIII. Alternatives

Forest management action alternatives are driven by a number of potentially conflicting considerations. What follows here is a guideline for a decision-making process to aid a land manager in creating reasonable alternatives and selecting a preferred alternative to implement a proposed management action. The range of possible alternatives for a given proposed action is defined by the nature of the site and resource conditions of an allotment parcel or parcels involved in the action. The detail and number of possible alternatives that would exist for all Native allotments within the management unit is beyond the scope of this plan. That is why this plan is focused on defining a process rather than defining a series of all possible management alternatives. Implementation of this plan will result in conducting this decision-making process for future proposed management actions. The nature of an individual action and its potential impacts will result in the process itself falling into one of several categories. Given that the categories are largely defined by the level of potential impacts associated with a proposed action, each category is associated with, and defined by, the nature of the NEPA process and documentation required for a process that falls within it. These process categories constitute the alternatives available when implementing this plan and are defined as follows:

A. ***Alternative 1- Plan Not Implemented (No-action alternative)***

The No-Action alternative in this case means that a Forest Management Plan is not implemented. Any management activities would be evaluated on their own merit with regards to potential impacts, NEPA compliance, and compliance with other statutes and regulations, or are not evaluated at all. Any past activities, having been executed in the absence of a plan, would fall into this category.

Consequences of Alternative A: This alternative would result in noncompliance with BIA requirements for implementation of Forest and Fire Management Plans on restricted Indian lands, and there would be no benefit to be gained by tiering from a programmatic plan.

B. ***Alternative 2 – Proposed Actions with Plan Implementation***

Implementation of this plan results in proposed actions on Native allotments being subjected to an analysis, resulting in the proposed action falling under one of several possible sub-alternatives:

C. ***Alternative 2a - Proposed Actions with No Significant Impact***

Proposed forest and fire management activities on Native allotments are evaluated using the specifications and criteria outlined in this plan, and are permitted to occur if they are deemed to pose no significant impact on the affected natural or human environment. The proposed activity is evaluated in terms of environmental and human impacts, including cumulative effects, after which it may be determined that the action qualifies for a categorical exclusion under NEPA guidelines implemented by the BIA. If so, required NEPA documentation would be limited to the paperwork documenting the categorical exclusion qualification. Otherwise, an Environmental Assessment (EA) would be required, accompanied by a Finding of No Significant Impact (FONSI) if it is still determined that no significant impacts result from the proposed activity. Much of the discussion and analysis required in the EA could be tiered from this plan.

Consequences of Alternative 2a: A decision to approve the proposed action would be made. The NEPA documentation generated by this process would take the form of a Categorical Exclusion if the action qualifies as such after evaluation, or the generation of an EA and FONSI if such a finding can be made. Reference to this plan through tiering could constitute much of the EA documentation.

D. ***Alternative 2b - Proposed Actions with Mitigated Impacts***

Proposed forest and fire management activities on Native allotments are evaluated using the specifications and criteria outlined in this plan, and potentially significant impacts are mitigated through modification of the activities or appropriate application of best management practices as discussed in this plan.

Consequences of Alternative 2b: A decision to approve the proposed action with an EA and FONSI. Reference to this plan through tiering could constitute much of the EA documentation.

E. ***Alternative 2c - Proposed Actions Resulting in Significant Impacts***

Proposed forest and fire management activities on Native allotments are evaluated using the specifications and criteria outlined in this plan, and potentially significant impacts are determined to be possible even with the inclusion of mitigation strategies in the application of the actions.

Consequences of Alternative 2c: A decision to approve the proposed activity would be a result of the analysis weighing the negative and positive impacts of the action. Costs, as represented by

negative impacts, would be weighed against the benefits, as represented by the positive impacts. If the benefits obviously and significantly outweigh the costs associated with the proposed action, an EA is prepared and the proposed action may be approved. If the benefits do not obviously outweigh the costs, or the proposed action involves some level of controversy, the process may be driven to require an Environmental Impact Statement (EIS) with a final Record of Decision (ROD). With either an EA or an EIS, as with the preparation of an EA in the previous alternatives, much of the required discussion and analysis could be tiered from this plan.

IX. PROCESS GUIDELINE

Compliance with this plan will involve all proposed forest and fire management actions to be considered in a process in which the proposed action is evaluated and a course of action is determined based on the evaluation. This process mirrors a NEPA process conducted for a proposed action, but the required NEPA documentation is not fully described here. For a more detailed description of required NEPA processes, refer to the BIA Alaska Regional Office NEPA Handbook.

Previous sections of this document will be useful for successfully conducting this process for a proposed action. Section III, "Description of the Affected Environment" is useful for detailed background information about the affected resources. Potential impacts by a proposed action on affected resources are outlined in Section VI, "Issues Concerns and Opportunities". Possible options for mitigating negative impacts to affected resources are found in Section VII, "Goals and Objectives" and in Appendix B, "Best Management Practices (BMP's) Extracted and Interpreted from the Alaska Forest Resources and Practices Act". Sections V and VI and Appendix B, describing forest and fire management practices, are useful for defining the range of proposed actions that may be employed by an allottee to attempt to meet an allottee goal. These various potential actions and resulting effects are presented in simplified lists and typically with regards to one affected resource at a time, but it is critical to consider resource interactions where they may occur and the cumulative effects of multiple actions in the decision-making process.

Following is a step-by-step description of the process that a manager would engage in during the planning phases of a proposed action on Native allotments that would conform to this plan:

A. ***Define the proposed action***

Possible proposed forest management actions include those discussed and listed in previous sections of this document. A proposed management action can originate from a variety of sources, but ultimately needs to specifically address an allottee goal and be endorsed by the allotment owners. A proposed action may be directly requested by the owners, it may be an

action specified in a stewardship plan or other document in place for an allotment parcel, or it may be solicited from the owners by a manager in response to funding availability, market opportunities, or other management opportunities.

To ensure that a proposed action reflects the goals of the allotment owners, the owners themselves need to be determined and consulted. Groups of owners may be directly involved if there are multiple owners for an affected parcel, or if there are potentially multiple parcels involved in a proposed activity. For a proposed activity to be considered on an allotment, owners representing over 50% interest in the parcel need to approve of the activity. The proposed activity must be defined as clearly and concisely as possible, with enough detail to enable proper evaluation of the action. Specific location, size, intensity, timing, and duration are factors to include in the action description.

B. ***Determine and notify adjacent landowners***

Proposed actions directed to a specific allottee goal may have impacts on other lands not directly involved in the management of a particular parcel. Most often, these will be those land parcels immediately adjacent to the allotment directly involved in the proposed action, and may include other allotments, private lands, corporation lands, and agency lands. Research land status for the area immediately adjacent to the allotment parcels involved in a proposed action. Notify the adjacent land owners of the nature of the proposed activity. If significant impacts are anticipated, extends the notification to any potentially affected landowners, adjacent or not. To help gauge cumulative impacts, the adjacent owners can be queried for the presence of past or future similar activities in the area of the proposed action.

C. ***Consultation to evaluate potential effects on cultural resources***

Evaluating for potential effects on cultural resources relies primarily on consultation with professional archaeologists and literature research of available information. There is a variety of legislation requiring the identification and proper handling of cultural resources, including the National Historic Preservation Act (NHPA), the American Indian Religious Freedom Act (AIRFA) and Executive Order 13007, the Native American Graves Protection and Repatriation Act (NAGPRA), and the Archaeological Resources Protection Act (ARPA). Key among these is Section 106 of the NHPA, which requires the BIA to evaluate the impacts of Native allotment actions on historic properties are on or may be eligible for the National Register of Historic Places. This is generally referred to as the "Section 106 review process", and is initiated early in the planning phase of a proposed action by consulting with the BIA Regional Archaeologist.

The geographic area within which the proposed action may cause changes, or "adverse effects", to historic properties is defined as the "area of potential effects", and is determined prior to conducting a field survey, or inventory, in that area. If cultural resources are identified during the archaeological inventory, the land manager will make every attempt to avoid these resources

through the recommended establishment of buffer zones or other mitigation measures, as appropriate.

Cultural resources that require consideration under this review include historic and archaeological sites and objects. In the forested areas, some sites that may require Section 106 compliance are prehistoric sites identified by semi-subterranean house depressions and cache pits. Historic and modern fish camps may have remains of fish racks, tent frames, caches, smokehouses, outhouses, and cabins. Cultural remains at a location have to be 50 years of age to be considered historic. Cabins may be either log or frame structures, and have to be considered under Section 106 if older than 45 years of age. Grave sites are protected by Alaska State laws (AS 11.46.482(a) (6) and AS 12.65.5) and by Federal laws (ARPA and NAGPRA).

Other parties are identified and consulted in this process, including the State Historic Preservation Officer (SHPO), Tribes, land owners, and other interested parties. The initial phase of a Section 106 review begins with background literature research using a variety of resources:

- Alaska Heritage Resources Survey (AHRS) maintained by the Alaska Office of History and Archaeology.
- BIA Regional Archaeology's Native allotment field inventories.
- BIA ANCSA's 14(h) (1) historic and cemetery site reports.
- Native allotment applications maintained by BIA Title Plant.
- Bureau of Land Management Native allotment conveyance files.
- Federal or State agency archaeological records where a Native allotment may be an in-holding.
- Archaeological publications
- USGS maps that may show a "cabin" or "ruins" or "winter trail"

Federal conservation unit cultural resources records Section 304 of the NHPA requires that information about the location, character, or ownership of a historic property be withheld from public disclosure if it is determined that disclosure may cause a significant invasion of privacy, risk harm to historic property, or impede the use of a traditional religious site by practitioners. Part of the recommendations coming back to a manager as a result of the Section 106 review should refer to the appropriate level of confidentiality and disclosure related to potentially affect historic properties and archaeological sites.

D. *Evaluate proposed action with regards to natural resources and impacts on the human environment*

Conceptually, the "human environment" can be considered to include the various natural resources to which human values can be attached. Fish and wildlife resources are important because of their value to human communities for subsistence and other uses; soil resources are

important because of their effects on productivity of human commodities and their effect on the overall environment; air quality is important because of potential impacts on human health, and so forth. A proposed management activity needs to be evaluated for its potential impacts, positive and negative, on the various natural resources that collectively affect the human environment. Previous sections of this document are designed to help guide that process.

Section III, "*Description of the Affected Environment*", and Section VI, "*Issues, Concerns and Opportunities*" provide useful background information to help guide a manager when determining the potential impacts of a proposed forest or fire management action on other resources. Section VII lists broad resource management goals and objectives to help guide a manager when determining how to modify or design a proposed forest or fire management action to meet management goals and mitigate potential negative impacts. The information provided in those sections is organized by resource; it is necessary at this point to evaluate these potential impacts and mitigation strategies simultaneously in order to determine the overall collective impacts. This is easier said than done, and the wide variety of potential activities and sites does not lend itself to a straightforward cookbook approach. That being said, there are a number of key items that can be extracted and highlighted from the objectives listed in Section VII to help clarify the process:

- For forest management actions involving timber cutting, clearing, road-building, and related activities, the requirements and regulations of the State of Alaska Forest Resources and Practices Act (FRPA) for Region I should be adopted to help mitigate potential negative impacts on soil, water, and fishery resources and address sustained yield management goals. A summary of the pertinent standards relating to water quality and fish habitat is given in the list of objectives in Section VII.F.
- For forest management actions involving timber cutting, clearing, road-building, and related activities, the Best Management Practices (BMP's) developed in conjunction with the FRPA should be adapted to help mitigate potential negative impacts to other resources. For reference, Appendix B has an extracted list of appropriate BMP's, organized by affected resource.
- Within the management constraints imposed by the proposed action itself, silvicultural actions involving timber cutting or clearing should be modified to promote enhancement of wildlife habitat, as described in the objectives in Section VII D.
- Timing and duration of prescribed burning activities should be managed to minimize negative air quality effects.
- State of Alaska Department of Environmental Conservation should be notified and approval should be sought for any prescribed burning activity.
- NEPA documentation requires that the presence of Threatened and Endangered (T&E) species be considered. In the course of preparing this document, documentation has been received from the U.S. Fish and Wildlife Service dated February 21, 2012 (Appendix A),

stating that the greatest concern for listed species of concern this time would be the staging areas of log rafts (debris, tannins, and substrate) that may detrimentally affect the benthic fauna. Additional consultation will be needed to confirm that this is still the case at the time and place of a proposed management action.

E. ***Conduct economic analysis as required***

An economic analysis of the proposed action should be conducted. Typically, this would take the form of a Cost-Benefit Analysis where the costs of the proposed activity would be weighed against the benefits. Costs and benefits in this case would be negative and positive impacts resulting from direct cash transactions. Revenues and costs associated with timber sales, reforestation activities and other forest development activities are considered over the length of a rotation, and appreciated or discounted accordingly.

Depending on the allottee goals, feasibility of a given proposed action need not be driven by the economic analysis; perceived non-cash benefits that address allottee goals would still be considered when deciding whether to implement an action. Uncertainties inherent in anticipated future costs and revenues resulting from management activities and reduction or increase in risk from losses resulting from wildfire or insects and diseases introduce can make the economic analysis very difficult or uncertain, but it still is a useful process when evaluating feasibility and impacts of a proposed action.

F. ***Evaluate cumulative impacts and landscape-level management implications***

Up to this point, a proposed forest or fire management action is primarily evaluated on its own merits. The action also needs to be evaluated in terms of its contribution to cumulative impacts resulting from the effects of this action and other activities that have occurred or may occur in the same relative time and space. Similarly, the proposed action needs to be evaluated for how well it conforms to landscape- or regional-level goals that may have been established.

Cumulative effects include direct and indirect effects, the significance of which can be difficult to objectively determine. The sensitivity of the affected resources and the timing and spatial distribution of multiple actions needs to be considered. Situations that produce what could be determined to be significant cumulative impacts in one place may not be considered significant somewhere else, and vice versa. The relative lack of substantial human activity in the vicinity of Native allotments in much of the Chugach Management Unit tends to downplay the importance of cumulative impacts, and the current situation indicates that cumulative impacts often may not be significant. However, each situation needs to be researched and other activities that have the potential to affect the same resources in the same area and time need to be identified and documented, and potential cumulative effects need to be objectively evaluated.

Perhaps the biggest questions that arise have to do with scale and intensity. How much is too much? How close is too close? How soon is too recent? Or, in what combination do all these

factors produce a situation where the cumulative effects are significant? A few broad guidelines could be considered, but specific situations where the question of significant impacts is not clearly answered would require the judgments of professional experts in the disciplines of the resources being potentially affected.

There are a few situations that appear to be particularly sensitive to the consideration of cumulative adverse impacts. The widespread and environmentally sensitive nature of fish resources and the waters they are found in dictates that cumulative impacts to fish habitat and water quality could be considered significant with relatively few adverse impacts over relatively large geographic areas such as entire watersheds. The cultural importance of fish and wildlife stocks to communities in the Chugach Management Unit and the migratory nature of those stocks make it critical to consider cumulative adverse impacts of management activities over large geographic areas such as watersheds or larger landscapes. Prescribed burning would tend to contribute to significant cumulative impacts if concentrated too much in the same time frame as other burning activity.

G. ***Determine if proposed activity qualifies for a Categorical Exclusion under NEPA.***

After conducting the review steps listed above, the proposed action may qualify for a Categorical Exclusion, minimizing the required NEPA documentation. Use the BIA *NEPA Handbook* to check to see if the proposed action qualifies as a Categorical Exclusion. This involves checking the list of qualifying actions to see if the proposed action qualifies as a possible categorical exclusion, and running through an exception checklist presented in Appendix 7 of the BIA NEPA Manual. The checklist involves a number of determinations involved in previous process steps (adverse effects on cultural resources, adverse effects on threatened and endangered species, adverse cumulative effects, etc.) If the use of a categorical exclusion is upheld, the proposed action can be approved, when accompanied by documentation required for the Categorical Exclusion itself (See BIA NEPA Handbook).

Some fire management planning actions, including preparedness plans, mobilization plans, and prevention plans, are not considered to be resource management planning, and as such do not require NEPA documentation and compliance. In addition, fire management activities that are considered to be emergency operations, including emergency rehabilitation plans, also do not require NEPA compliance.

Following is a list of forest management activities extracted from 516 DM 10.5 that qualify for Categorical Exclusions. Several of these only qualify if they are in compliance with a current management plan addressed in an earlier NEPA analysis (i.e. this document):

- Free-use cutting to allotment owners for personal use not exceeding 2,500 board feet.
- Cutting permits for forest products not exceeding $25,000 in value.
- Annual logging plans.

- Fire Management Plan Analysis detailing emergency fire suppression.
- Emergency forest and range rehabilitation plans limited to environmental stabilization on less than 10,000 acres.
- Forest stand improvement projects less than 2000 acres.
- Timber management access skid trail and logging road constructions.
- Prescribed burning plans less than 2000 acres.
- Forestation projects with native species and associated protection and site preparation activities.

If the proposed forest or fire management action qualifies as a Categorical Exclusion, all that remains for approval is to complete the exception checklist Appendix 7 of the BIA NEPA Manual. Most of the items on the checklist should have already been considered in the previous steps. If all items on the checklist are answered with "No", then the checklist itself is complete, signed, dated and attached as pertinent NEPA documentation. In this case, the process completes with a selection of Alternative B, "Proposed action with no significant impact". Otherwise, proceed to the next step.

H. ***Prepare an Environmental Assessment, and determine if there are significant impacts.***

Using the information collected and evaluated in the previous steps, prepare an Environmental Assessment (EA) using the BIA NEPA Handbook as a guide in structuring the document. The EA will include a list of alternatives and the selection of a preferred alternative for the implementation of the proposed activity. If implementation of the preferred alternative is deemed to not produce significant impacts on the human environment, a Finding of No Significant Impact (FONSI) may be prepared to accompany the EA, completing the NEPA process. If the action as initially proposed is still essentially what is proposed in the preferred alternative, this result in this process completing with Alternative B, "Proposed action with no significant impact". If the evaluation of the proposed action resulted in substantial measures being recommended to mitigate adverse effects of the proposed action, but still results in a FONSI, then the result of this process is Alternative C, "Proposed Action with Mitigated Impacts".

If there are deemed to be significant impacts, then the positive impacts are weighed against the negative impacts and evaluated. It can be difficult to conduct this analysis objectively since some of the impacts will be difficult to measure and compare, but this can be thought of as a cost/benefit analysis where the negative impacts can be thought of as costs of implementing the proposed action and positive impacts can be thought of as benefits. Obvious dominance of the positive impacts over the negative impacts would result in the selection of the preferred alternative and approval of the EA, although a FONSI will not apply. Negative impacts are greater than the positive impacts or an unclear result would result in requiring the preparation of an Environmental Impact Statement (EIS) for the proposed action. Both of these processes result in this process concluding with Alternative D, "Proposed Action with Significant Impacts."

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XI. Appendices

Appendix A- NEPA Documentation

Questionnaire for beneficiaries of Restricted Native Allotments/Restricted Townsite Lots in the Chugachmiut Region

Name: _____ Village: _____

Address: _____

Contact Number: _____

1. **How does your Native Allotment serve you?

   Subsistence Gathering Cabin Site Recreation Site

   Business Site Home Site Future Home Site

   Other: _____

2. **Do you get forest products from your Native Allotment?

   House Logs Firewood Food or Medicinal Plants

   Other: _____

3. **Are you concerned about forest insects, diseases and wildfire damaging or killing trees on your Native Allotment?

   Yes No

   Comments: _____

4. **Do you have an interest in developing a business, partitioning, or selling your Native Allotment/Townsite Lot?

   Yes No

   Comments: _____

5. **Have you rough sawn lumber cut locally? Would you like to see more rough sawn lumber available locally?

Yes No

Comments: _____

6. **Are you concerned about unauthorized use or trespass on your Native Allotment/Townsite Lot?

Yes No

Comments: _____

7. Would you like to be contacted by a representative of Chugachmiut Forestry or Realty about the management of your Native Allotment/Townsite Lot?

Yes No

Comments: _____

8. Below you will find a list of all the services provided to a Restricted Native Allotment/Restricted Townsite Lot owner. Please check the boxes next to services you would like to hear more about.

- ☐ GIFT DEEDS
- ☐ ADVERTISED SALES
- ☐ NEGOTIATED SALE BY DEFERRED OR CASH PAYMENT
- ☐ EXCHANGE
- ☐ RE-PURCHASE
- ☐ LEASE
- ☐ USE PERMIT
- ☐ GRAVEL PERMIT/SALE
- ☐ MORTGAGES
- ☐ RIGHTS-OF-WAY/ EASEMENTS
- ☐ SUBDIVISIONS
- ☐ PARTITIONS
- ☐ DISPOSAL BY WILL/PROBATE
- ☐ REMOVAL OF RESTRICTIONS
- ☐ SERVICE LINE AGREEMENTS
- ☐ TRESPASS

☐ CADASTRAL SURVEY PROGRAM

☐ TIMBER SALES/HARVESTING

☐ FOREST HEALTH (I.E. BARK BEETLE/WIND THROW)

9. Please write any additional comments/concerns below. Thank you for your assistance.

**Chugachmiut as a forestry service provider is required by the National Indian Forest Resources Management Act P.L. 101-630 to develop a management plan for Native trust lands. Answers to these questions will help us better understand your goals and concerns and may encourage further discussion. Answers to these questions will also be used for aforementioned forestry management plan.

If you have any questions while completing this questionnaire you can call Nathan Lojewski, Forestry Manager or Sabrina Savo, Realty Officer at 1-800-478-4155

Results of Questionnaire for beneficiaries of Restricted Native Allotments/Restricted Townsite Lots in the Chugach Region

10. **How does your Native Allotment serve you?

Subsistence Gathering	14/18	Cabin Site	8 /18	Recreation Site	6/18
Business Site	1/18	Home Site	2/18	Future Home Site	6/18

Comments received in the "other" section are listed below:

1. Also used for village subsistence
2. Too many landowners so landowner doesn't use property at all

11. **Do you get forest products from your Native Allotment?

House Logs	2/18	Firewood	10/18	Food or Medicinal Plants	11/18

Comments received in the "other" section are listed below:

1. they also gather cottonwood for smoking fish

12. ****Are you concerned about forest insects, diseases and wildfire damaging or killing trees on your Native Allotment?**

Yes	16/18	No	2/18

Comments received in the "other" section are listed below:

1. Very Concerned regarding Spruce Bark Beetle
2. Very Concerned about Beetle Kill
3. Spruce Bark Beetle
4. Beetle Infestation
5. Would like someone to check their lot for the above mentioned items

13. **Do you have an interest in developing a business, partitioning, or selling your Native Allotment/Townsite Lot?

Yes	8/18	No	7/18
Not sure	1/18		
Maybe	3/18		

Comments received in the "other" section are listed below:

1. Would like to develop a tourist site possibly, it is a very nice peaceful place for relaxing and would like to develop a hiking trail of some sort to get to the mountain from the landowner's property.
2. Would like to develop the property
3. Would like to develop a business or another home, but would not like to sell
4. Would like to possibly develop a business
5. Maybe develop a lodge of some sort
6. Would like to build a home but there are too many owners

14. **Have you rough sawn lumber cut locally? Would you like to see more rough sawn lumber available locally?

Yes	9/18	No	8/18
Not sure	1/18		

Comments received in the "other" section are listed below:
1. It would help the village or landowner build at their properties
2. Would allow it but not from his portion of the property

15. ****Are you concerned about unauthorized use or trespass on your Native Allotment/Townsite Lot?**

Yes	14/18	No	4/18

Comments received in the "other" section are listed below:
1. Would like there not to be any trails or roads authorized through their property
2. Landowner is concerned but people use it regardless
3. One landowner stated they were not concerned because people ask

16. **Would you like to be contacted by a representative of Chugachmiut Forestry or Realty about the management of your Native Allotment/Townsite Lot?**

Yes	17/18	No	1/18

Comments received in the "other" section are listed below:
1. One landowner is gift deeding her property to her children and upon completion she would like us to contact them and not her
2. Landowner request contact at some point if something affects her property
3. Please
4. A landowner would like us to contact them when we come down for our public meetings

17. Below you will find a list of all the services provided to a Restricted Native Allotment/Restricted Townsite Lot owner. Please check the boxes next to services you would like to hear more about.

5/18	**GIFT DEEDS**
2/18	**ADVERTISED SALES**
	NEGOTIATED SALE BY DEFERRED OR CASH PAYMENT
3/18	**EXCHANGE**
	RE-PURCHASE
3/18	**LEASE**

5/18	**USE PERMIT**
2/18	**GRAVEL PERMIT/SALE**
1/18	**MORTGAGES**
4/18	**RIGHTS-OF-WAY/ EASEMENTS**
4/18	**SUBDIVISIONS**
5/18	**PARTITIONS**
4/18	**DISPOSAL BY WILL/PROBATE**
	REMOVAL OF RESTRICTIONS
	SERVICE LINE AGREEMENTS
9/18	**TRESPASS**
3/18	**CADASTRAL SURVEY PROGRAM**
2/18	**TIMBER SALES/HARVESTING**
13/18	**FOREST HEALTH (I.E. BARK BEETLE/WIND THROW)**

18. Please write any additional comments/concerns below. Thank you for your assistance.

1. Landowner cannot find property corners, he thinks the earthquake might have moved them on east end of property marker went "down." Would like to have a new survey done to find/mark corners on property
2. Landowner does not want roads or trails across allotment
3. 2 more landowners cannot find property corners
4. Landowner is interested in preserving the land in the state it is in
5. Landowner is potentially interested in partitioning for individual parcels through CARS program if funds are available
6. Landowner would like to know how to subdivide with multiple owners
7. Landowner is concerned about outside hunters from dogfish & and another island in the area being trespassed on for hunting
    A. possibly gate the road to control access was a suggestion made to eliminate problem
8. Landowner would like the piled branches left surrounding their cabin to be chipped, they were left by the FireWise crew.
    A. They think the FireWise crew did a good job cutting makes it more open
9. Landowner wasn't sure how to tell when the beetles are infesting their land

10. Landowner is concerned there may be people using metal detectors to find artifacts
11. Landowner would like to see the landowners being helped and not made to fight each other when they ask for help and not take years to get something looked at and resolved.
12. Landowner thinks that every landowner should get their own access to their property via the IRR Road Project.
13. Landowner would like to find a way to have all owners of their allotment they inherited come to an agreement of sorts. Thinks maybe have a survey and do a lottery type deal to divvy up the property.
14. Landowner observed insect damage at dogfish that is affecting shrubs and berry leaves
15. Landowner is not concerned about trespass, they think that the land should be used by everyone except the hunters who land on the lakes and try to access the land through dogfish

Community Meeting Sign in Sheets and Public Comment Postings

Community Meeting Sign in Sheets and Public Postings are on file in Chugachmiut's Records.

US Fish and Wildlife Service section 7 ESA consultation letter.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

in reply refer to:
AFWFO

February 21, 2012

Mr. Nathan Lojewski
Forestry Manager
Chugachmuit Regional Corporation
1840 South Bragaw Street
Anchorage Alaska 99508

Re: Chugachmuit native Allotment Forest Management Plan (*Consultation number 2012-0061*)

Dear Mr. Lojewski:

Thank you for your letter of February 1, 2012, requesting consultation pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*. as amended; ESA) for endangered or threatened species that could be affected by the implementation of the proposed programmatic Forest Management Plan for Native Allotment parcels in your service area, Prince William Sound vicinity. The U.S. Fish and Wildlife Service (FWS) is happy to assist you with consultation on listed species under our agency's jurisdiction. However, please note that the National Marine Fisheries Service (NMFS) has management authority for many marine mammals that are protected by the ESA and /or the Marine Mammal Protection Act (MMPA), as well as for essential fish habitat. For information on these subjects, please contact Mr. Brad Smith in the Protected Resources Division of the NMFS at (907) 271-3023.

Project Description
The purpose is to present a plan for forest resource management of the of individually owned Indian trust allotments within the Chugach region. The plan will attempt to present a series of Best Management Practices (BMP's) and alternatives to implementation, intended to help individual allotment owners and land managers make informed decisions about the management options that best meet their goals. The plan will apply to approximately 86 Native allotment parcels and several hundred owners of those parcels with a total area of 9,025 acres. In addition to ensuring adherence to statutory and regulatory requirements protecting timber, fisheries, wildlife, cultural and other resources, the plan would also serve as a forest management practice educational tool for allotment owners and heirs, interested tribal governments, tribal members, interested members of the public, and regulatory agencies.

ESA Species of Concern
Our records indicate that no federally listed or proposed species, or designated or proposed critical habitat, under FWS jurisdiction occur within the action area of the proposed project. However, two candidates for listing, Kittlitz's murrelet (*Brachyramphus brevirostris*) and yellow-billed loon (*Gavia adamsii*), could occur within your forest management plan area. Candidate species are those for which our agency has sufficient information to warrant proposing to list as endangered or threatened, but such proposals have not yet been published in the Federal Register. These candidates are not protected under the ESA, but you are encouraged to consider them in your planning process, as they may become listed in the future.

Kittlitz's murrelets may be present in the Prince William Sound area at all times of year. Unlike most other members of the Auk family, these small diving seabirds are solitary breeders that nest inland from the coast, on rocky slopes and talus above timberline in coastal mountains. However, these murrelets feed year round in the nearshore marine environment, often in glacially-influenced waters. Their diet includes small fish (.e.g., sand lance, herring, capelin), amphipods and small crustaceans. The abundance and condition of these prey items can of course be influenced by water quality.

Although Kittlitz's murrelets nest on the ground in unvegetated areas, they could potentially be disturbed if forest management activities occur nearby, or if timber access roads traverse their scree or talus habitat. They could also be affected by forestry operations that result in sedimentation or other effects to the nearshore marine environment.

Yellow-billed loons nest farther north Alaska, but Prince William Sound is within the species' wintering range. The species feeds on small to medium-sized fish, which it captures by diving far below the water's surface. Specific characteristics of yellow-billed loon wintering habitats are not well known, but the species normally occurs in protected nearshore marine waters. Like the Kittlitz's murrelet, these loons could also be affected by forestry operations that result in sedimentation or other effects to the nearshore marine environment.

ESA Effects Determination

It is the responsibility of the action agency to determine if a proposed action may adversely affect a listed species or critical habitat. Again, this ESA section 7 procedure is not required for candidate species, but it is advisable. For more information on the section 7 process, you may visit: http://alaska.fws.gov/fisheries/endangered/pdf/consultation_guide/20_Process_Narrative.pdf. But also, please do not hesitate to contact our office if you would like assistance with making your determination.

Migratory Birds

Under the Migratory Bird Treaty Act (16 U.S.C. 703; MBTA), it is illegal for anyone to "take" migratory birds, their eggs, feathers or nests. In Alaska, all native birds except grouse and ptarmigan (protected by the State of Alaska) are protected under the MBTA. Destruction of active bird nests, eggs, or nestlings that can result from spring and summer vegetation clearing, and other timbering operations would violate the MBTA. The attached timing guidelines are not regulations, but are intended as recommendations to help you comply with the MBTA (Attachment I).

This letter relates only to migratory birds, ESA species, and critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service; it does not address species under the jurisdiction of the National Marine Fisheries Service, or other responsibilities under the Fish and Wildlife Coordination Act, Clean Water Act, National Environmental Policy Act, Marine Mammal Protection Act, Bald and Golden Eagle Protection Act, or other legislation.

Thank you for considering the effects of your project to endangered, threatened, and other rare species in Alaska. If you have any questions about this letter or other ESA or MBTA issues related to this project, please contact me at (907) 271-1467 or Endangered Species Biologist Judy Jacobs at (907) 271-2768, and refer to consultation number 2012-0061. You may also contact us by email at ellen_lance@fws.gov or judy_jacobs@fws.gov.

Sincerely,

Ellen W. Lance
Endangered Species Branch Chief

Attachment I: Migratory Bird Timing Guidance

Appendix B-Best Management Practices (BMP's)

Interpreted from the Alaska Forest Resources and Practices Act of 2003
(Johnson, 2005)

A. ***BMP's Specific To Disposal of Waste Materials***

i. Prevent any petroleum-contaminated soils or materials from entering and polluting surface waters.

ii. Remove all petroleum products and their containers from the operating area. Remove all oil-contaminated filters, absorbent pads, or soils from the operating area.

iii. Dispose of all petroleum products or petroleum contaminated waste material in accordance with the requirements of DEC.

iv. Prevent metal or leachates from oxidation of metal parts from entering and polluting surface waters.

v. Remove all machine parts, wire rope, scrap culverts, and similar scrap metal from the operating area.

vi. Dispose of all scrap metal in accordance with the requirements of DEC.

B. ***BMP's Specific To Operating in Riparian Areas***

i. Identify and correctly classify all surface waters so appropriate and applicable BMP's can be implemented on them.

ii. All surface waters found in the field with a perennial flow along a defined channel, or an intermittent flow along a defined channel significant for protection of downstream water quality should be identified on a map of harvest operations. Factors in determining whether the stream is significant for protection of downstream water quality are: frequency of flow; volume of flow the channel can hold; stability of banks and bed material; amount of debris in the channel; and volume of flow in the receiving water body.

iii. Prevent depositing any more erodible material than necessary near a surface water, to minimize scour, bank erosion, or debris jams and debris torrents.

iv. Protect the riparian area immediately adjacent to a stream so the vegetation can continue to function as a filter strip and remove sediment carried by runoff from the road.

v. Minimize the amount of sediment that enters a riparian area, to lessen the likelihood of overwhelming the capability of the filtering vegetation to remove sediment.

vi. Avoid side casting excess overburden and excavated material into a riparian or other designated area to the maximum extent feasible.

vii. Avoid locating roads within a riparian area except to cross a water body, or if there is no other feasible location for the road. The road should be located

outside the riparian area, unless locating the road outside the riparian area is likely to cause slope failures, excessive erosion, or sedimentation that would have a greater adverse impact on the stream.

viii. Minimize the amount of road construction and resulting disturbance within a riparian area. Eroded material close to the stream is more likely to cause sedimentation because of fewer opportunities to design sediment control features into the drainage system.

ix. Prevent unnecessary crossings, which can contribute sediment.

x. A road within a riparian area must be designed and located to minimize significant adverse effects on fish habitat and water quality.

xi. Locate the road away from or upstream of a meander bend or recently abandoned channel.

xii. Where feasible, cross stream channels at right angles.

xiii. Locate the road to fit the topography.

xiv. Avoid deep gullies with fine textured soils when constructing roads.

xv. Include drainage features that minimize or direct road runoff away from any adjacent stream, and effectively control sediment.

xvi. Prevent felled or bucked timber from entering streams.

xvii. Leave high stumps in the riparian area where they will not cause frequent hang-ups or other operational difficulties when yarding.

xviii. Avoid creating conditions conducive to erosion and stream sedimentation. Trees or logs rolling downhill can disrupt soils and damage the streambed or banks. A tree or log in a stream can change the flow pattern.

xix. Avoid changing sediment storage and the rate of sediment transport through a stream system. Damage to the streambed or banks can destabilize the stream channel causing additional scour of the streambed or erosion of the banks. Avoid creating conditions conducive to initiation of debris torrents. Debris carried into streams, or existing material and debris mobilized by activity in the stream channel may form unstable debris dams, especially in steep, incised channels. If these structures fail under the right conditions they can lead to debris torrents.

xx. Prevent felled or bucked timber from entering streams. In steep areas, leave high stumps in the riparian area where they will not cause frequent hang-ups or other operational difficulties when yarding the setting. Trees or logs rolling downhill can disrupt soils and damage the streambed or banks. A tree or log in a stream can change the flow pattern.

xxi. Avoid changing sediment storage and the rate of sediment transport through a stream system. Damage to the streambed or banks can destabilize the stream channel causing additional scour of the streambed or erosion of the banks. Avoid creating conditions conducive to soil erosion adjacent to surface waters.

Avoid disturbances to the bed and banks of a stream caused by removing logs that enter the stream channel during yarding operations

xxii. Avoid creating conditions conducive to initiation of debris torrents. Debris carried into streams, or existing material and debris mobilized by activity in the stream channel may form unstable debris dams, especially in steep, incised channels. If these structures fail under the right conditions they can lead to debris torrents.

xxiii. Prevent damage to trees designated for retention (buffers) in a riparian area. Prevent damage to soils or understory vegetation caused by equipment operating in a riparian area.

xxiv. Minimize operation of track or wheeled equipment operation in a riparian area, minimizing ground disturbance. Prevent damage to retained timber, understory vegetation, and soils. Unless one end of a log is suspended, skidding a turn of logs through a riparian area can cause extensive damage to soils and remaining trees. Maintain one-end suspension of logs. Minimize the number of skid routes through a riparian area.

xxv. Shovel yarding should rarely require a skid trail within the riparian area. An exception might be where a stream is crossed to shovel log a small patch of timber on the other side without having to construct a road. Where feasible, the operator should reach into the riparian area to remove a log after having positioned the shovel outside the riparian area. Trees within a riparian area should have been felled and bucked so any log segment is reachable from outside the riparian area. A large log might require walking a shovel in and out of the riparian area to enable it to lift the log and achieve the required one end suspension, or to reach logs resulting from an approved harvest variation. If so, the shortest possible route should be followed. Maneuvering around a rock outcrop may also be a reason for entering a riparian area.

C. ***BMP's Specific To Timber Harvesting and Water Resources***

i. Locate landings where they, and the operations conducted from them, will have the least impact on surface waters. Landings are focal points for harvest operations, and many impacts associated with harvesting activities can be minimized by selecting appropriate landing locations.

ii. Prevent deposition of logs and debris in surface waters. The large amount of waste and debris generated at a landing can end up in adjacent surface water if the landing is located too close, or on a hillside immediately above the water body.

iii. Avoid creating conditions conducive to erosion, mass wasting and stream sedimentation. Landings can disturb a lot of ground, drainage from haul and yarding roads lead towards them, and they can intercept ephemeral drainages. Landings are generally level and at least partially built on fill. Constant equipment operation and standing water can cause excessive deformation of the surface material and generate sediment. Poor drainage combined with the

weight of fill material on steep side hills can lead to fill failures and mass wasting.

iv. Locating landings on ridges or benches along the hillside can greatly reduce the amount of excavation and fill required to construct them. They should not be built larger than needed to accommodate setting up the yarder or processor, and for safely landing and loading logs. If the landing is located on steep or unstable slopes, it should be constructed to prevent soil erosion and mass wasting. The landing, as well as trails and roads leading to it, should be effectively drained.

v. Harvest operations should avoid creating conditions favorable to erosion and mass wasting by protecting residual trees and understory vegetation. Their undisturbed root systems retain and stabilize soils.

vi. Harvest operations should avoid disturbing large woody debris embedded in the streambed or banks of streams. Avoid creating conditions conducive to erosion and stream sedimentation. Removing large woody debris decreases stream roughness and can cause scour or erosion.

vii. Avoid changing sediment storage and the rate of sediment transport through a stream system. Disturbance of large woody debris can release stored gravel, reduce the capacity of the stream to store gravel, and increase the gravel transport rate through the stream system. Avoid impacting habitat forming structures in the stream channel. Large woody debris can form pools and riffles important for fish, so disturbance should be minimized. Less disturbance minimizes chances of erosion, stream sedimentation, changes to sediment storage and transport patterns, and loss of fish habitat.

viii. Avoid falling trees into a stream and avoid creating conditions conducive to erosion and stream sedimentation. Falling trees into streams can damage the streambed or banks. Streams flowing around the tree, as well as tree removal, can cause further damage.

ix. Avoid changing sediment storage and the rate of sediment transport through a stream system. Avoid creating conditions conducive to debris torrents. As previously mentioned, new debris, or existing debris mobilized by activity in the stream channel, may form unstable debris dams, especially in steep, incised channels. If these structures fail they can cause debris torrents.

x. All trees felled into non-fish-bearing surface or standing waters and their debris should be removed at the earliest feasible time, to the extent necessary to avoid degradation of water quality. Any significant amount of debris that may cause degradation of water quality in the stream or in downstream segments of the stream must be removed. Sometimes removing a tree or a log from a stream can cause more damage to the streambed or banks and riparian area than leaving it. As such, the Forester in Charge should evaluate each situation.

xi. For all track or wheeled skidding operations, avoid disturbance to the ground cover and the soil, to minimize erosion and stream sedimentation. Locate and design skid trails to minimize sedimentation by keeping them from leading toward surface waters, minimizing the width of skid trails, and ensuring good drainage. Use water bars or other appropriate techniques as necessary to prevent or minimize sedimentation. Outslope skid trails where feasible, unless

an inslope is necessary to prevent logs from sliding or rolling downhill off the skid trail. Bumper logs and/or trees can be used to protect stream banks and frozen ground and a layer of snow can help reduce the impacts caused by cross-stream yarding.

xii. Use puncheon where significant ground disturbances may contribute to sedimentation of surface water. Puncheon helps to spread the weight of equipment over the ground, reducing the depth and amount of ground disturbance and protecting underlying vegetation. Again, frozen ground and a layer of snow can greatly reduce the impacts from skidding operations, especially on wet sites.

D. ***BMP's Specific To Road Construction and Water Resources***

i. When it is necessary to cross wetlands in order to access forest resources, construct temporary winter roads instead of all season permanent roads. Frozen soils and snow help minimize compaction and disturbance to soil resources and associated vegetation. Stream and river crossings are generally easier as well, and impacts to stream banks and stream channels is minimized

ii. Prevent or minimize sedimentation. Avoid generating sediment that can enter streams. Prevent or minimize erosion of unstable soils. Treat unstable soils with effective and appropriate erosion control measures.

iii. Sedimentation is less likely the farther away the road is from the stream. Intervening vegetation or terrain features can filter and trap sediment. Low spots or intervening ridges can intercept runoff, allowing suspended sediment to filter or settle out before reaching surface waters. Unstable soils usually must be stabilized before any measures can be taken to prevent or minimize erosion and revegetate exposed soils.

iv. Avoid overloading unstable slopes with fill for road construction or sidecasted material. Avoid mass wasting and remember that slope failures are most likely to occur when soils are saturated, can result in landslides or debris torrents. Avoid erosion of sidecasted material. Use end-hauling or full-bench construction techniques if mass wasting from overloading on an unstable slope or erosion of sidecast material is likely to occur and cause degradation of surface or standing water quality.

v. Fill for road construction or sidecasting excavated material should not be placed on unstable slopes (can cause landslides or debris torrents). Fine-grained, erodible material should not be sidecasted in the vicinity of surface waters, but rather taken to a disposal site where the terrain and vegetation allows suspended sediment to filter or settle out before runoff from the site can reach any surface waters. To determine whether the slope is unstable, look for evidence of past slope failures (overgrown slide paths, colluvial fans, slumps, or other depositional areas), slopes greater than 67%, or J-butted trees. To determine whether soils are susceptible to mass wasting, look for poorly drained marine sediments, a strike of bedrock conducive to sliding, and ephemeral drainages.

vi. When falling trees for road construction, fall trees away from all fish-bearing waters, standing waters, and other surface waters. Do not fall a tree into anadromous fish waters cataloged under AS 41.14.870 without prior written approval of the Office of Habitat Management and Permitting (OHMP). If introduced, remove limbs and other small debris from other fish-bearing waters within 48 hours, and remove the bole as soon as the necessary equipment is at the site. If introduced, remove debris from nonfish-bearing surface waters and standing waters at the earliest feasible time when necessary to avoid degradation of water quality.

vii. Dispose of waste material created during road construction where it will not enter surface waters, away from surface waters and/or with vegetation suitable for filtering or settling out suspended sediments. Deposit all material in a suitable upland site stabilized by effective and appropriate erosion control measures.

viii. Keep roads constructed on unstable soils well drained through the construction of drainage systems. Also when a road is confined by a hillside, runoff from the road and ephemeral drainages from the hillside must be collected. Short sections of road that cut through a ridge may not require a ditch if the road can be graded or banked so that runoff will drain off the road within a short distance. If a ditch is needed on the uphill side of a road, it should be constructed as an integral part of the road, collecting runoff from the hillside and road surface. It should be close enough to the road so a grader can pull and clean it. Straight sections of road should visually slope to the outside edge of the road. Winding sections should be distinctly banked to direct runoff towards the inside corner of the curve and off the road. Runoff should rapidly seek the outer edge of the road and should not flow for an extended distance down the road.

ix. Avoid exceeding the capacity of the ditch by allowing runoff flowing down the ditchline to be relieved before it can overwhelm the capacity of the ditch and flood the road. As flows increase, so does their capability to cause erosion, especially on steeper grades. Runoff collected by the road drainage system needs to be spread out across the hillside to avoid erosion that would be caused by a more concentrated flow, and allow vegetation to filter out suspended sediment. To the extent feasible, direct ditchline runoff away from unstable soils and surface waters, and onto vegetative areas. Discharges should also be directed away from stream channels and intermittent stream channels. A drainage structure should be provided as close as practical to the stream crossing to relieve the ditchline before flows reach the crossing site. Drainage relief should be provided where outflows can percolate into the soil, or drainage should be directed through sufficient vegetation to remove suspended sediment before reaching surface waters.

x. Less frequent spacing of drainage structures is permissible if the parent material of roadbed is not erodible, such as rock or gravel, or the topography is not conducive to erosion. More frequent spacing is required where soil is unstable or where peak flows require more drainage structures to prevent degradation of

surface water quality. Ditchline flows need to be reduced where the grade increases, and where soils are highly erodible. Wetter hillsides require more drainage structures to handle anticipated flows. If subsurface flow dominates on a well-drained hillside, roads will usually not intercept subsurface flows, requiring fewer drainage structures. Discharges near surface waters should be minimized, potentially requiring additional relief structures to reduce the drainage area. Fewer drainage structures may be needed where the terrain prevents runoff from reaching surface waters. Sediment entering surface waters indicates a need for more drainage structures.

xi. Drainage structures must be capable of handling peak flows (estimated by width and depth of channel at high water mark).

xii. Streams with floodplains require addition drainage considerations when designing and constructing the approach road and crossing structure. Most floodplains have side or overflow channels that will be crossed by approach roads; sometimes they are hidden by brush or vegetation, and may be intermittent or limited to flood events. To determine the extent of the floodplain, examine vegetation, sediment deposits, or debris trapped by brush or other understory vegetation. A relief dip should be incorporated into the approach road to allow for passage of flood waters that exceed the drainage design for the road and it should be located where it will protect the bridge abutments from erosion but away from any side channels.

xiii. Any permanent log or wood bridge must be firmly anchored at one end as water under a wooden bridge can float it and carry it off its abutments. The bridge must be securely anchored to a physical structure that will not be disturbed by floodwaters, typically by: 1) drill steel driven through the sill logs into the ground, 2) sills tied back to large stumps along the approaches, or 3) to deadmen buried in the approach fills. The bridge superstructure must also be tied to the bridge sills. Anchors must be capable of withstanding high flows that overtop the stream banks. Stumps should be firmly fixed in the ground, and not be affected by floodwaters that overtop the stream banks in the vicinity of the crossing. Deadmen should be covered by large rock that will not be moved by floodwaters, and buried in sections of the road that are protected from erosion and have adequate overflow drainage structures installed. This BMP applies to bridge approaches constructed from readily erodible materials. Approaches constructed with rock should still have retaining walls or other structures adequate to keep fill material from entering surface waters. Erodible material must be protected from erosion by plantings, seeding, riprap or other ground cover. Retaining walls, bulkheads, or other means may also be employed. Sill logs or other abutments for the bridge should be installed back from the edge of the bank and above the line of ordinary high water to avoid encroaching on the stream. Bridge construction that involves activity within the channel of an anadromous stream requires a Title 16 permit.

E. ***BMP's Specific for Culverts***

i. For fish-bearing waters, the entrance (to the extent possible) and exit of a stream culvert must match the natural course of a stream channel, and a culvert may not be perched at its inlet or outlet. During low flows perched culverts may prevent fish passage, especially for small fry or smolt. Under ADF&G criteria a culvert perched more than four inches does not provide adequate fish passage. High flows through a perched culvert tend to erode the streambed below the culvert outlet, generating sediment and increasing the perch height. Also, stream flows redirected by a skewed culvert can erode the stream banks and change the course of the stream. Ideally culverts should be bedded to match the stream channel such that gravel can fill the bottom of the culvert. The deposition of gravel within the culverts increases roughness, helps to maintain the original stream gradient and reduces flows through the culvert that may inhibit fish passage. The inlet should be buried so that the culvert is as level as possible. Under ADF&G criteria a culvert with spiral corrugations, 48" and less, does not provided adequate fish passage if the gradient is greater than 1%. Burying the inlets also helps the culvert fill with gravel.

ii. Material at the outlet of the culvert must be adequate to resist or reduce the erosive force of the discharge. If material is not resistant, additional measures must be taken to minimize erosion, for example, the installation of a half round, flume, downfall culvert or similar structure. Outfall from that structure must be protected from erosion.

iii. For culverts installed on nonfish-bearing waters along a forest road, prevent mobile slash generated during harvest activities from being carried downstream and blocking a culvert inlet. This will ultimately prevent culverts from washing out. Clear the stream channel for 50 feet above the culvert inlet of mobile slash or debris that may be expected to plug a culvert. The larger the stream, the more likely high flows will mobilize slash left in the stream and carry it down to the culvert inlet. If only a small amount of slash, or small pieces, are left after cleaning the stream, the more likely it is the culvert will continue to function adequately. The few pieces of slash that don't pass through the structure can be cleaned out during routine road maintenance. If the slash or debris is imbedded, it is less likely to become mobile.

iv. To insure drainage enters and flows through a culvert, instead of bypassing the culvert and down the ditch or over the road and where the parent soil material allows, and interference with fish passage is avoided, install a catch basin to collect water and direct it into the inlet of a culvert. Catch basins are often needed to collect ditch water and divert it into a relief culvert. Side drainages that are not incised, or along roads with a slight bench cut, will often need catch basins to direct side drainages into a culvert and keep flows from diverting down the ditchline.

v. Culverts must be of sufficient length to prevent road overlay material from blocking the ends of the culvert. The ends of the culvert must extend beyond the fill far enough to keep material from sloughing into the entrances to the culvert. The greater the depth of fill over the culvert the longer it will have to be. Also allowance in the length of the culvert is needed to anticipate the widening of the road over time due to maintenance practices.

vi. Keep all culverts and ditches functional when maintaining active roads. When maintaining active roads, keep the road surface crowned or outsloped during operations and keep the downhill side of the road free from berms, except those intentionally constructed for the protection of fill.

vii. For inactive roads, keep the road surface crowned, out-sloped, or water barred and left in a condition that is not conducive to erosion (Johnson, B, 2005).

E. BMP's Specific To Soil Resources:

i. Choose your landing locations wisely. Landings are focal points for harvest operations, and many impacts associated with harvesting activities can be minimized by selecting appropriate landing locations. Avoid creating conditions conducive to erosion, mass wasting and stream sedimentation. Landings can disturb a lot of ground, drainage from haul and yarding roads lead towards them, and they can intercept ephemeral drainages. Locate landings where they, and the operations conducted from them, will have the least impact on surface waters. Landings are generally level and at least partially built on fill. Constant equipment operation and standing water can cause excessive deformation of the surface material and generate sediment. Poor drainage combined with the weight of fill material on steep side hills can lead to fill failures and mass wasting.

ii. Locating landings on ridges or benches along the hillside can greatly reduce the amount of excavation and fill required to construct them. They should not be built larger than needed to accommodate setting up the yarder or processor, and for safely landing and loading logs. If the landing is located on steep or unstable slopes, it should be constructed to prevent soil erosion and mass wasting. The landing, as well as trails and roads leading to it, should be effectively drained.

iii. Harvest operations should avoid creating conditions favorable to erosion and mass wasting by protecting residual trees and understory vegetation. Their undisturbed root systems retain and stabilize soils.

iv. For all track or wheeled skidding operations, avoid disturbance to the ground cover and the soil, to minimize erosion and stream sedimentation. Locate and design skid trails to minimize sedimentation by keeping them from leading toward surface waters, minimizing the width of skid trails, and ensuring good drainage. Use water bars or other appropriate techniques as necessary to prevent or minimize sedimentation. Outslope skid trails where feasible, unless

an inslope is necessary to prevent logs from sliding or rolling downhill off the skid trail. Bumper logs and/or trees can be used to protect stream banks and frozen ground and a layer of snow can help reduce the impacts caused by cross-stream yarding.

v. Use puncheon where significant ground disturbances may contribute to sedimentation of surface water. Puncheon helps to spread the weight of equipment over the ground, reducing the depth and amount of ground disturbance and protecting underlying vegetation. Again, frozen ground and a layer of snow can greatly reduce the impacts from skidding operations, especially on wet sites.

vi. When it is necessary to cross wetlands in order to access forest resources, construct temporary winter roads instead of all season permanent roads. Frozen soils and snow help minimize compaction and disturbance to soil resources and associated vegetation.

vii. Avoid overloading unstable slopes with fill for road construction or sidecasted material. Avoid mass wasting and remember that slope failures are most likely to occur when soils are saturated, can result in landslides or debris torrents. Avoid erosion of sidecasted material. Use end-hauling or full-bench construction techniques if mass wasting from overloading on an unstable slope or erosion of sidecast material is likely to occur and cause degradation of surface or standing water quality.

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ix. Dispose of waste material created during road construction where it will not enter surface waters, away from surface waters and/or with vegetation suitable for filtering or settling out suspended sediments. Deposit all material in a suitable upland site stabilized by effective and appropriate erosion control measures.

x. Keep roads constructed on unstable soils well drained through the construction of drainage systems. Also when a road is confined by a hillside, runoff from the road and ephemeral drainages from the hillside must be collected. Short sections of road that cut through a ridge may not require a ditch if the road can be graded or banked so that runoff will drain off the road within a short distance. If a ditch is needed on the uphill side of a road, it should be constructed as an integral part of the road, collecting runoff from the hillside and road surface. It should be close enough to the road so a grader can pull and clean it. Straight sections of road should visually slope to the outside edge of the road. Winding sections should be distinctly banked to direct runoff towards

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xiii. Water bars are needed when a skid trail causes soil disturbance or changes drainage patterns. Examples include skid trails crossing a hillside, running downhill towards a surface water, impeding overland flows (even on flat ground), causing extensive soil disturbance, or intercepting a number of ephemeral drainages.

xiv. Water bars should be constructed across the width of the skid road. They should be at an angle to the skid road with the downhill end lower to facilitate drainage. The downhill side of the upper end should be blocked as necessary to prevent runoff from going around the end of the water bar. Both ends of the water bar should be free of obstructions. On flat grades the water bar can provide cross-flow drainage for overland flows and should be dug deep enough to prevent ponding.

xv. Water bars need to be located and spaced frequently enough to divert runoff from the skid trail before it picks up enough volume and velocity to cause

significant erosion. Severely disturbed soils may need additional measures to stabilize them and prevent erosion. Measures such as re-vegetating exposed soils or covering the skid trails with slash can protect the exposed soils from rainfall-induced rill erosion.

xvi. Keep all culverts and ditches functional when maintaining active roads. When maintaining active roads, keep the road surface crowned or outsloped during operations and keep the downhill side of the road free from berms, except those intentionally constructed for the protection of fill.

xvii. For inactive roads, keep the road surface crowned, out-sloped, or water barred and left in a condition that is not conducive to erosion.

March 30, 2015

Chugachmiut
Attn: Nathan Lojewski, Forester
1840 Bragaw Street, Suite 110
Anchorage, Alaska 99508

COPY

Dear Nathan,

I am writing this letter to let you know that I am interested in selling the blown down timber on my property in Port Graham, Allotment Number 7196, US Survey 7629, Lot 11. Please move forward with beginning the timber sale process and keep me updated of your progress. I have some suggestions and requests which I would like addressed in the Silviculture prescription on my allotment.

Sincerely

MATERIAL SAFETY DATA SHEET

HYDRONIC SYSTEM CLEANER

MSDS
DATE: 5/1/10

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HYDRONIC SYSTEM CLEANER
SYNONYMS: None

MANUFACTURER: THE NOBLE COMPANY
ADDRESS: 7300 Enterprise Drive; Spring Lake, MI 49456

EMERGENCY PHONE: (231) 799-8000
OTHER CALLS: (231) 799-8000
FAX PHONE: (231) 799-8850

COMMON NAME: Aqueous cleaning solution of nitrites, nitrates and sodium tetraborate.

SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT:	CAS NO.	% WT
SODIUM NITRITE	7632-00-0	3-8%
SODIUM METASILICATE	6834-92-0	2-7%
SODIUM TETRABORATE	1330-43-4	2-6%
SODIUM NITRATE	7631-99-4	1-3%
SODIUM HYDROXIDE	1310-73-2	1-5%
WATER	6771-18-5	>80%

SECTION 3: HAZARDS IDENTIFICATION

ROUTES OF ENTRY: Skin absorption, inhalation, eye contact, ingestion.

EYES: Will cause irritation upon contact.

SKIN: Prolonged contact with skin can cause irritation.

INGESTION: Irritating to mouth, throat, and stomach. May cause discomfort, nausea, vomiting and diarrhea.

INHALATION: No hazard in industrial use.

CARCINOGENICITY: Product is not considered a carcinogen by OSHA, NTP or IARC.

MEDICAL CONDITIONS: Pre-existing eye or skin conditions may be aggravated by over-exposure to this product.

SECTION 4: FIRST AID MEASURES

EYES: Immediately flush eyes with plenty of water for 15 minutes. Seek medical attention.

SKIN: Wash area with soap and water. Seek medical attention if irritation persists.

INGESTION: Induce vomiting. Only give CONSCIOUS victim two glasses of water and seek medical attention. NEVER give UNCONSCIOUS anything by mouth.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. Seek medical attention. Inhalation hazard unlikely due to low volatility of product.

SECTION 5: FIRE-FIGHTING MEASURES

FLASH POINT: N/A

Product will not support combustion.

SECTION 6: ACCIDENTAL RELEASE MEASURES

SPILL/LEAK PROCEDURES: Notify safety personnel, evacuate all unnecessary personnel and provide adequate ventilation. If feasible and without risk, clean-up personnel should stop leak. All clean-up personnel should wear proper personal protective equipment.

SMALL SPILL: Clean with inert absorbant and place in recovery drums for disposal.

LARGE SPILL: Dike to prevent further migration of material. DO NOT release into waterways or sewers. Follow applicable federal and state regulations.

SECTION 7: HANDLING AND STORAGE

STORAGE REQUIREMENTS: Store in clean, dry locations away from excessive heat.

HANDLING PRECAUTIONS: Wash thoroughly after handling. Do not get into eyes, on skin, or on clothing. Do not smoke while using this product. Do not use near excessive heat, sparks, or open flame.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Eye wash station and safety shower.

VENTILATION : Strong general ventilation or local exhaust.

RESPIRATORY PROTECTION: Organic vapor air purifying respirator if vapors are a nuisance or if the concentrations are above PEL or TLV.

EYE PROTECTION: Chemical splash goggles with indirect or no ventilation.

SKIN PROTECTION: Chemical resistant gloves such as nitrile.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: None

WORK HYGIENIC PRACTICES: Never eat, drink, or smoke in work areas.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Purple liquid.

ODOR: No odor

PHYSICAL STATE: Liquid

pH AS SUPPLIED: 12.0

BOILING POINT: BT 212-215 F

SOLUBILITY IN WATER: Soluble

VAPOR DENSITY: >1

SPEC GRAV/DENSITY: 1.09

SECTION 10: STABILITY AND REACTIVITY

STABILITY: Material is stable under normal storage conditions.

CONDITIONS TO AVOID (STABILITY): Excessive heat and open flame.

INCOMPATIBILITY (MATERIAL TO AVOID): Strong oxidizing and reducing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: **c**arbon monoxide, carbon dioxide.

HAZARDOUS POLYMERIZATION: Cannot occur.

SECTION 11: TOXICOLOGICAL INFORMATION

LD50
SODIUM NITRITE: 120 mg/kg (oral)
SODIUM NITRATE: 4300 mg/kg (oral)
SODIUM TETRABORATE: 3200 mg/kg (oral)

SECTION 12: ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: No data.

SECTION 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: As a waste, this product in its raw form DOES NOT MEET the criteria of a hazardous waste as defined by RCRA (40CFR361). Dispose of in accordance with all applicable state, federal, and local regulations.

SECTION 14: TRANSPORT INFORMATION

DOT/ DOMESTIC: Not regulated

EXPORT: Not regulated

SECTION 15: REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS

OSHA: Considered hazardous material as defined by 29CFR1910.1200

SARA TITLE III :

311/312 (40CFR370) If stored in excess of the threshold quantities, this product should be reported as a(n):
*IMMEDIATE (acute) HEALTH HAZARD

313 (40CFR372) This product does not contain ingredients which are subject to the reporting requirements of SARA 313.

SECTION 16: OTHER INFORMATION

CALIFORNIA PROPOSITION 65: This product does not contain ingredients which are on the current Proposition 65 list.

NEW JERSEY RIGHT TO KNOW: This product contains the following ingredients which are non-hazardous, but are amonth the top five ingredients in this product:

Water	CAS#	7732-18-5
Sodium Nitrite	CAS#	7631-99-4
Sodium Nitrate	CAS#	7631-00-0
Sodium Tetraborate	CAS#	1330-43-4

OTHER INFORMATION: This document is generated for the purpose of distributing health, safety, and environmental data. It is not a specification sheet nor should any displayed data be construed as a specification.

PREPARATION INFORMATION: The information presented herein, while not guaranteed, was prepared by technically knowledgeable personnel and to the best of our knowledge is true and accurate. It is not intended to be all-inclusive, and the manner and conditions of use and handling may involve other or additional considerations. Consult *Noble Company* for further information.

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DESIGN REVIEW COMMENTS

Project: Chugachmiut Biomass Facility Review Type: 100% Review Reviewer: Chris Gaul
Organization DOE/NREL START program
Phone # (303) 384-6161 Date 10/31/2013 RESPONSE BY: George Richmond

#	Reference Page/Paragraph/ Drawing #/Etc.	Comment If possible, provide correct information or reasoning for comment	Resolution Acceptance of comment or the justification to reject
1	E2.1	Unit heater schedule lists 1500 watt heater. Panelboard schedule lists Heating/A.C. (H.) at 15.0 Kva. Is this a 1,500 watt or 15,000 watt heater?	1500W obviously. Panel schedule will be corrected to 1.5kVA.
2	E2.1	Lighting Fixture Schedule. Designation A fixture uses 54 watt T5HO fluorescent lamps. These lamps cost $29 each in lower 48. A 40 lamp case of lamps is over a $1000 from W.W. Grainger. Suggest a fixture using commonly available lamps. Use standard incandescent fixtures and upgrade to LED if desired.	Fixture lamp(s) were changed to T8. Incandescents hardly seem a good choice with the manufacturing restrictions in place.
3	E2.1	Lighting Fixture Schedule. Exterior lighting. Schedule calls for HPS fixture. How is it controlled? Drawing does not show switch or photo eye. Recommend rapid start fixture with daylight/motion sensor. HPS fixtures take a long time to come to full brightness. On a quick fueling stop the operator will be gone before the light is up to brightness.	After brief discussion with Patrick Norman, it was decided that all four exterior fixtures (HPS) will be controlled via a switch inside the door and a photocell. The normal operation will be switch on and photocell controlling the fixtures (day/night).
4	E2.1	CP-1 and CP-2 need local disconnects.	The electrical dwg will be modified to show motor starters at each motor.
5	E2.1	No means of motor control shown on electrical drawing	Same answer as comment 4.
6	E2.1	No model number listed for UH-1 Berko electric heater.	Unit heaters are generic and the intent is to allow the contractor to choose the brand to reduce cost.
7	E2.1	How is unit heater controlled? Wall mounted or integral thermostat?	Integral thermostat. Req. added to equipment schedule.
8	M0.1	Mechanical notes not pertinent to rest of design. Should refer to Alaska codes instead of WSEC.	Standard notes. Will revise to reference Alaska energy code.
9	Not used		

10	Not used		
11	M0.2 detail 1	Pumps need isolation valves for service and flow balancing.	Isolation valves are shown in Hydronic Piping Diagram, Sht M2.2. No flow balancing required. Boiler system is not pressurized, pump circulates hot water through heat exchanger in Heating Plant Building at constant volume flow. District Heating Loop to buildings has automatic flow controls at every building heat exchanger. No pump flow control required.
12	M0.2 detail	Pressure gauges in wrong location to accurately measure pump differential head. Should be located adjacent to pump. Preferred design is single gauge with ball valves between suction and discharge to eliminate differences in gage calibration.	Difference of opinion. Gauges in close proximity to pumps are affected by turbulence. Design shown is simpler. System design is constant volume (simpler) and pump pressures are not critical, only used for verification of flow.
13	M0.2 Heat exchanger schedule	HX- Why is a 450 psi rated heat exchanger specified for a system operating at a few psi?	Standard pressure rating for product specified. Product will be listed as “Or Equal” and performance will be primary criteria.
14	M0.2 Heat exchanger schedule and Detail 2	Why use Heat Flo thermal storage tanks in individual buildings? Thermal storage already accomplished in Garn boiler. A brazed plate heat exchanger takes up less room and costs less.	It was a choice. Heat Flo product cost is approximately $1,200 each while quick search online shows brazed plate at approx. $400. We have concerns that plate heat exchangers will add too much flow resistance to building heating systems. Heat Flo product is very low pressure drop. Brazed Plate type may be considered as “or equal”.
15	M0.2 Detail 2	Need flow control valve that limits from district system and assures high temperature differentials back to Garn boiler. Constant flow systems waste electricity.	Not sure what the point is here. Garn design separates the boiler water from the district system. Two separate water systems. The Garn boiler is not pressurized. High temperature differentials are used in high efficiency systems, which this is not. Please explain.
16	M0.2 Detail 3	Need detail, note, or specification on sealing pipe penetration into vaults.	Note will be added.
17	M0.2 Detail 3	How are copper branch pipes to buildings insulated?	Specification for insulation has been provided. Will also add to table on M0.2

18	M0.2 Detail 4	Why use individual pipes? Simplify installation and reduce cost with dual conduit in single insulated jacket.	
19	M0.2 Detail 5	Are future valves supported in some manner to keep torsion on main pipes?	Should be. Will add.
20	M0.2 Detail 6 and M1.1 Hydronic Schedule	M0.2 Detail 6 Note refers to direct bury piping. M1.1 Sheet Note 3 refers to direct bury piping. M1.1 Hydronic Schedule lists four different pipe sizes. Does design really require 2", 1.5". 1.25", 1", and ¾" direct bury pipe sizes? Why not simplify material delivery and installation with 2" and 1.5"?	Design will be reviewed. This is an opinion and not cost saving.
21	M0.1 Pump Schedule	Aurora 4300 pumps have seals and couplings. Recommend close-coupled pump without mechanical seals.	Agreed and changed.
22	M0.2 Pump Schedule	Constant speed pumps waste expensive electricity. Running two 1.5 HP pumps 7000 hours per year will cost $3,000. Use smart ECM variable speed pumps to save electricity expense.	Constant speed pumps and constant volume pumping systems are simpler to operate and easier to use. Use of ECM pumping requires sophisticated controls and variable flow pumping, which are not part of the existing design. We are not aware of any ECM pumps larger than small circulators.
23	M0.2 Storage Tank Schedule and M2.2 Hydronic Piping Diagram	What is purpose of ST-1? Garn boiler has 2000 gallon thermal storage. The way ST-1 is plumbed it is just a piece of fat pipe. With 36 gpm flow it will change water in 3 minutes so no thermal storage benefit is gained.	As stated elsewhere, there are two water systems. This small storage tank is on the District Heating system and is there for pumping stability. The District Heating system has little water volume in it and very little above the floor level where the pump is located.
24	M0.2 Detail 2	Add bypass valve so existing boiler can still run if heat exchanger is shut off.	Adds complexity and cost for unknown benefit.
25	M0.2	No air separator shown on schedules. Recommend Spirotherm to remove dissolved air. Typical air scoops only remove bubbles and are of limited value. No pot feeder shown on schedules.	Air separator shown in schematic on sheet M2.2. Boiler loop (open, vented) doesn't require one. Small system is hard to justify added cost for Spirotherm.
26	M2.2	How are chemicals added to Garn boiler?	Factory tablets furnished by Garn after startup and water testing by Garn. Also annually.
27	M1.1 Hydronic Schedule	Garn boiler rated at 700,000 BTU/hour when fired every 3 hours. Heat load given as 678,000 BTU/hour. Garn Boiler will have to be stoked 5-8 times a day throughout heating season. Has it been verified that this thermal output is appropriate for the existing heat load of the buildings	Heating load was quickly estimated based on square footage. Design was initially based on Garn model 3200 but lower output (from memory; 400MBH?) When Garn revised their

		that will be on the district system?	model 3200 to 700MBH in August, we just revised flows to distribute potential heat available. Heating capacity will depend on many factors, including wood BTU content, dryness, stoking methods and frequency. System design is intended to distribute whatever heat is available as far as it goes.
28	M2.1 Detail 1 and 2	Boiler room layout is unworkable. Why place expansion tank directly in front of fuel door? How is operator supposed to maneuver heavy cordwood into Garn boiler with 2 feet between open door and tank? Inadequate room to maneuver ash removal tools, fuel carts, or maintain the equipment.	Boiler Room layout is approximate. Our scope does not include providing design for a new/larger building which is required. Expansion tank location is approximate and should be coordinated with Contractor at time of construction.
29	M2.1	This building is not suitable as a boiler house. Insufficient fuel storage space and access. Must have an overhead door for fuel and maintenance with separate man door for operator access.	Agreed, existing building is not suitable. The larger output Garn product is also much larger physically than original product at start of design phase.
30	General Note	No fuel storage area shown.	

ENERGY CROP BIOMASS FUEL SUPPLY AGREEMENT©

BETWEEN

Port Graham Village Corporation

And

Port Graham Village Council

Sample Agreement

Alaska

ENERGY CROP BIOMASS FUEL SUPPLY AGREEMENT

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ENERGY CROP BIOMASS FUEL SUPPLY AGREEMENT

THIS ENERGY CROP BIOMASS FUEL SUPPLY AGREEMENT ("Agreement") is entered into this __ day of _____ 2014 by and between Port Graham Village Council, an Alaska Native Village Council ("Buyer") and Port Graham Village Corporation ("Seller").

WITHNESSETH

WHEREAS, Buyer is a Alaska Native Village run community, intends to build, own, and operate an biomass heat utility which supplies heat services to a population of approximately 125; and

WHEREAS, Buyer's ability to provide a dependable and reasonably price supply of biomass heat to its service base is vital to the economic well being of the community; and

WHEREAS, the term "biomass" as referred to in this Agreement, shall exclusively mean Energy Crop Biomass grown for the sole purpose of providing a fuel source for heat generation, as defined in Section 2.5 of this Agreement. The Parties acknowledge that the above definition of "biomass" is a material provision of this Agreement.

WHEREAS, in its operation, Buyer requires a dependable and high quality biomass fuel source with the experience and capability necessary to supply Buyer's biomass fuel requirements; and

WHEREAS, Seller is a competent supplier of biomass fuel, owning or controlling or having exclusive right to offer biomass fuel for sale sufficient to partially meet the requirements of Buyer, and desires to supply biomass fuel to Buyer; and

WHEREAS, Buyer wishes to purchase biomass fuel from Seller and Seller wishes to sell biomass fuel to Buyer;

WHEREAS, Buyer and Seller shall be collectively referred to as the "Parties".

NOW THEREFORE, in consideration of the mutual covenants contained herein, and such other good and valuable consideration the receipt thereof being hereby acknowledged, Seller agrees to sell biomass fuel and Buyer agrees to purchase biomass fuel on the terms and conditions set forth herein.

SECTION 1. PURPOSE AND INTENT

Seller recognizes that Buyer is a community utility which has power sales contracts with other utilities within the State of Alaska. Throughout this Agreement, Buyer, its customers and such other utilities will be relying on the continued operation of the Boiler station as a source of heat for their various needs.

Both the Buyer and Seller agree that the primary fuel source of the Generation Station to meet operation requirements, is currently, and is expected to continue to be from traditional fossil fuels (i.e., fuel oil or possibly natural gas products such as propane). Seller further acknowledges that an adequate and continuous biomass energy crop fuel supply to the Boiler station, upon the terms and conditions of the Agreement, is essential to Buyer's ability to meet environmental initiatives (which, at the time of this Agreement are primarily voluntary) and renewable energy marketing objectives, while also providing heat and services at affordable rates.

By signing this Agreement, Buyer is placing reliance upon Seller to furnish the needed portion of its fuel supply at competitive prices to meet environmental and marketing initiatives. The Parties acknowledge that the above described interests of Buyer are material provisions of this Agreement.

SECTION 2. DEFINITIONS

As used herein, the following terms shall have the following meanings:

2.1 **Annual Base Line MMBTU Per Ton** - Shall mean a MMBTU (million BTU) value of biomass fuel based on the Alaska Energy Authority's estimate for Sitka Spruce to contain 19.3-21.7 MMBtu/cord with a dry cord weight of 1960-2520 pounds and a green cord weight of 3190-4100 pounds. The moisture content of dry weight is estimated at 12% with 40-60% for green wood[1].

2.2 **Annual Quantity** -- the project requires an estimated 125 bone dry tons (100 cords) per year[2] as received by Buyer during the contract year, adjusted for the yearly average of an independent lab analyses of the BTU content per cord of wood above or below the Annual Base Line MMBTU Per Ton.

2.3 **As Received** -- The composition and condition of the biomass fuel at the instant it is delivered to the Boiler station.

2.4 **Base Price** -- The price establish in accordance with Section 9 hereof.

2.5 **Biomass Fuel** – plant material including trunks, stems, leaves, and twigs harvested for fuel feed-stock to produce heat, not having a duel commercial use.

[1] *Port Graham Biomass Project* Prepared for Port Graham Village Council and Chugachmiut by Chena Power and Winters & Associates, June 2014, Page 9.

[2] *Port Graham Biomass Project*, Page 8.

2.6 **Biomass Fuel Property** -- The designated source or sources for the biomass fuel to be supplied hereunder, as defined in Section 2.13.

2.7 **BTU** (British Thermal Unit) -- The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

2.8 **Calendar Quarter** -- Any of the following three month periods during the contract year:
January, February, March
April, May, June
July, August, September
October, November, December

2.9 **Contract Document** -- Contract Documents or Agreement shall mean:
Seller's letter dated _____, 2015
This Biomass Fuel Supply Agreement
Any Addenda to this Agreement

Any reference to Contract Documents or Agreement shall also mean any renewal period.

In the event of an inconsistency between the Contract Documents, they shall be interpreted in the following priority:

1. Any Addenda to this Agreement
2. This Energy Crop Biomass Fuel Agreement
3. Seller's letter dated _____, 2015

2.10 **Contract Year** -- The period of 12:00 a.m. January 1 through 12:00 a.m. January 1 of the next succeeding year.

2.11 **Delivered Price** -- Shall mean the price of biomass fuel F.O.B. biomass fuel storage yard or boiler station, as selected delivery point of sales.

2.12 **Delivery** -- That point in time when the biomass fuel passes through the truck trailer into the Buyer's Biomass Yard's Hopper/Bin. Title for a trailer load of biomass fuel shall pass to Buyer upon completion of the unloading operation.

2.13 **Energy Crop Plantation** -- Shall mean the Seller's Site, where Biomass Energy Crops will be planted, maintained, harvested, and transported from, to the Boiler station.

2.14 **FERC** -- The United States Federal Energy Regulatory Commission.

2.15 **Force Majeure** -- Shall mean any event or cause beyond the reasonable control of a Party that cannot be prevented or eliminated by the exercise of due diligence, as defined in Section 12 of this Agreement.

2.16 **Generation Station** -- Port Graham, Alaska Biomass Heat Plant Site.

2.17 **Promissory Demand Note**: Shall mean a legally binding financial obligation (under the laws of Alaska) of the Buyer to compensate Seller at a stipulated future time or event, under terms and conditions specified in the Promissory Demand Note, as contained in Appendix C of this Agreement.

2.18 Renewable Energy: Shall mean a definition of "Renewable Energy" as is defined in U.S. Federal Government or State of Alaska Legislation that is enacted, and is in force, during the term of this Agreement, requiring Buyer to sell heat produced from Renewable Energy Generation Sources. Potential examples of Renewable Energy Generation may include, solar, wind, biomass, geothermal, or hydro-electric.

SECTION 3. TERM

3.1 Term -- This Agreement shall be for a term of five (5) years and shall commence on _____, ____, and shall continue until _____, ____, unless terminated sooner in accordance with the Contract Documents. Fuel Delivery and Purchases of Biomass Fuel shall be for a Term of 5 (5) years and shall commence on _____,____ (representing the date of first commercial harvest and delivery of biomass fuel to the Boiler station), and shall continue until _____, ____, unless terminated sooner in accordance with the Contract Documents.

3.2 Term Extension -- This Agreement shall have the option to extend a term of five (5) years, Term Extension, after end of Term and subsequent extensions of a five (5) Term Extension may be added upon written agreement between both parties and shall commence on _____, ____, and shall continue until _____, ____, unless terminated sooner in accordance with the Contract Documents. Fuel Delivery and Purchases of Biomass Fuel agreement shall have the option to extend a term of five (5) years, Term Extension, after end of Term and subsequent extensions of a five (5) Term Extension may be added upon written agreement between both parties and shall commence on _____,____ (representing the date of first commercial harvest and delivery of biomass fuel to the Boiler station), and shall continue until _____, ____, unless terminated sooner in accordance with the Contract Documents.

SECTION 4. REPRESENTATIONS

4.1 Representations and Warranties of Buyer. Buyer hereby represents and warrants to Seller, with the intention to induce the Seller to enter into this Agreement, that on the date hereof:

4.1.1 The execution and delivery of this Agreement by Buyer has been duly authorized by all necessary action and this Agreement constitutes a legal, valid and binding obligation of Buyer enforceable against Buyer in accordance with its terms, subject to applicable laws.

4.1.2 Buyer warrants that it is a community corporation validly organized and constituted under the laws of the State of Alaska and is duly qualified to perform all the acts required herein.

4.1.3 Buyer represents that sufficient resources are presently available in its current

budget year to meet its obligations under the terms of the Contract. Provided however, if Buyer, in future budget years, fails to appropriate sufficient funds to enable it to meet its payment obligations contained herein, this Agreement shall be terminated effective upon expiration of the fiscal year in which sufficient funds were last appropriated.

4.2 Representations and Warranties of Seller. Seller hereby represents and warrants to Buyer, with the intention to induce Buyer to enter into this Agreement, that on the date hereof:

4.2.1 Seller is an owner who is in the business of producing biomass for fuel and is organized as a corporation duly incorporated, validly existing and in good standing under of the laws of the State of _____ and is fully qualified to do business in such other jurisdictions in which its business and activities require qualification

4.2.2 The execution and delivery of this Agreement has been duly authorized by all necessary corporate action and this Agreement constitutes a legal, valid and binding obligation of Seller, enforceable against Seller in accordance with its terms.

4.2.3 Seller has received the approval of any public regulatory body having jurisdiction necessary to perform its obligation under this Agreement. The execution and delivery of this Agreement and the requirements hereunder do not require the consent of any third Party nor will they result in a breach or default of any other Agreement to which Seller is a Party or by which Seller is bound.

4.2.4 Seller warrants that the Biomass Fuel Property shall be planned and professionally maintained to contain economically recoverable biomass fuel of the quality and quantities which will be sufficient to satisfy the requirements under this Agreement. Seller warrants to notifying the Buyer of any material change of expected quantities within 30 days of any change in expected quantities from the Biomass Fuel Property.

4.2.5 That the biomass fuel to be supplied under this Agreement shall be delivered to Buyer free and clear from any covenants, restrictions, liens or other encumbrances of any nature whatsoever upon delivery to Buyer.

4.3 Representation and Warranties of Both Parties: Both the Buyer and Seller agree that adequate due diligence has been performed by both Parties on the planned source of the Biomass Fuel, and both Parties agree that the planned source.

4.4 Additional Representations and Warranties of Seller: Seller further represents that any activities that Seller is responsible for (but not including any change in law enacted subsequent to the time of this Agreement), including but not limited to selection of crop species, planting, harvesting, processing, and transportation of the Biomass Fuel that would result in the Biomass Fuel not qualifying as a suitable fuel as defined under Section 7 of this agreement shall constitute a material default of this Contract.

SECTION 5. QUANTITY

5.1 **Minimum Annual Quantity**. As defined in Appendix A of this Agreement, and except as adjusted by other sections of this Agreement, for each year during the Agreement, Seller shall offer to sell (if available) and deliver, and Buyer shall be financially obligated to purchase Delivery (as defined in Section 2.12) As Received (as defined in Section 2.3) of the following minimum annual tonnage ("Annual Minimum Quantity") bone dry tons:

ANNUAL MINIMUM QUANTITY

Contract Year	Sitka Spruce	Willow	Total Tons
1	None	None	None
2	None	None	None
3	125	None	125
4	125	None	125
5	125		125
6	125		125
7	125		125
8	125		125
9	125		125
10	125		125
11	125		125
12	125		125
13	125		125
14	125		125
15	125		125

5.2 **Delivery Schedule** -- The Annual Quantity shall be shipped in accordance with a seasonal delivery schedule, itemized by month, supplied by Buyer to Seller as further provided in Section 5.3 and in Appendix A 1.8 of this Agreement. The Parties agree that the time requirements contained in the schedule are of the essence of this Agreement, and failure by Seller to deliver in accordance with the delivery schedule shall constitute a material default of this Contract and is specifically with the meaning of Section 18 of this Agreement. Buyer agrees that Force Majeure or Environmental Force Majeure shall not constitute a material default of this Contract.

5.3 **Seasonal Delivery Schedule** --On or before _____, ____, Buyer shall specify by written notice to Seller the monthly quantities to be delivered in the Contract year. Buyer reserves the right to revise the seasonal schedule no later than the first day of the month preceding the next succeeding Calendar Month.

SECTION 6. SOURCE AND DELIVERY

6.1 **Source**. The biomass fuel sold hereunder shall be supplied from the designated source or sources (as defined in Appendix A) which shall be referred to as the Biomass Fuel Property. Seller may provide biomass fuel from other sources of a quality equal to or better than in the Quality Specifications in Section 7.1 of this Agreement, and which, in Buyer's sole judgment, performs adequately in Buyer's equipment, with all freight costs and related expenses occasioned by the use of substitute biomass fuel to be borne by Seller, if Seller is the sole fuel delivery supplier. An alternate fuel supplier may relieve the obligation of seller of the quantity of fuel designated for delivery on a cord by cord basis described in this agreement. If the seller is the sole fuel delivery supplier, the effective cost to Buyer of such substitute biomass fuel shall not be greater than the Delivered Price would have been had the biomass fuel been supplied from the Biomass Fuel Property.

6.2 **Truck Delivery**. Buyer and Seller hereby select truck transportation as the method of shipment for all biomass fuel under this Agreement. Title to and risk of loss of biomass fuel will pass to buyer and Delivery of biomass fuel will be considered to have been made when it is unloaded at the buyer's fuel storage yard or the Boiler station, whichever is designated by Buyer to Seller. Seller represents that prior to the execution of this Agreement, that Seller has familiarized itself with the Buyer's Fuel Yard and at the Boiler station.

SECTION 7: QUALITY AND SPECIFICATION OF BIOMASS FUEL

7.1 **Quality.** A. The biomass fuel delivered hereunder shall conform to the following specifications on a formal basis As Received and shall be deemed to be Conforming Biomass Fuel as follows or by Method B that follows:

	Test Number	Contract Typical	Contract Guaranteed	Contract Rejection	Units
Dry Basis[3]					
Ash, Dry	ASTM D 5142	0.44			% By Weight
Heat of Combustion	ASTM D 5865	8,611			Btu/lb
Carbon, Dry	ASTM D 5373	47.22			% By Weight
Hydrogen, Dry Basis	ASTM D 5373	6.11			% By Weight
Nitrogen, Dry Basis	ASTM D 5373	0.08			% By Weight
Chlorine, Dry Basis	ASTM D 3761	48			~~mg~~/kg
Sulfur, Dry Basis	ASTM D 4239	0.01			% By Weight
As Received—example					
Moisture, Total	ASTM D 2013	51.46			% By Weight
Ash, As Received	ASTM D 5142	0.94			% By Weight
Heat of Combustion	ASTM D 5865	4,238			Btu/lb.
Carbon, As Received	ASTM D 5373	24.91			% By Weight
Hydrogen, As Received	ASTM D 5373	2.73			% By Weight
Nitrogen, As Received	ASTM D 5373	0.11			% By Weight

[3] https://www.ecn.nl/phyllis2/Biomass/View/3043

Chlorine, As Received	ASTM D 3761	242	mg/kg
Sulfur, As Received	ASTM D 4239	0.04	% By Weight
General			
Heat of Combustion, MAF	ASTM D 5865	8,902	lbs/mmBtu
Sulfur -- lbs/mmBTU	ASTM D 3180	0.01	lbs/mmBtu

Seller warrants that it will deliver Biomass Fuel which consistently complies with the Guaranteed Specification. The Rejection Specifications set forth above are included as an accommodation to the Seller to allow for its occasional production variables. Delivery of Biomass Fuel, not at the Contract Guaranteed or Contract Typical Specifications as hereinabove defined, although not rejectable, for prolonged periods of time shall constitute a material breach of this Agreement. B. Buyer recognizes that much of the initial Biomass Fuel supply from Seller will constitute windthrown trees representing various ages of deterioration that could be graded in terms of number of years after windthrow. Seller and Buyer recognize that the quality of windthrown trees Btu/pound capability decreases in time. A graph of the density loss of Sitka spruce logs is included in a graph shown in Appendix B Quality of Biomass. A suggested scale in the decrease of stumpage fees is shown in Section 9.5.1 of this document.

7.1 Size -- Not more than __10_ % by weight of the Woody Biomass Fuel delivered pursuant to this Agreement shall have a size of greater than 20 feet in length (20') to Buyer's fuel storage yard. Any wood delivered to Boiler station shall be less than or equal to four (4) feet in length and round wood greater than sixteen (16) inches in diameter shall be split to less than sixteen (16) inches in diameter. The Biomass Fuel, As Received, shall conform to the specifications set forth above with respect to size, quality, consistency and other physical characteristics so that loading and handling at Buyer's plants(s) can be consistently accomplished without difficulty. Each Delivery of Biomass Fuel to Buyer shall be substantially uniform in quality and physical characteristics.

7.2 Non-conforming Biomass Fuel -- Any Biomass Fuel not in compliance with the Specifications set forth in Section 7.1 is deemed to be non-conforming Biomass Fuel. Buyer reserves the right to reject non-conforming Biomass Fuel in accordance with the terms of this Agreement. For each Delivery of Biomass Fuel, Seller shall notify Buyer, prior to or at the time of arrival at the Boiler station, of the following:

- The number of tons shipped
- The date and time of the estimated delivery to the Boiler station.

To assist Seller in determining compliance with the terms of this Agreement, Buyer shall conduct and provide Seller with the results of a "short proximate analysis" of the Biomass Fuel "As Received" at the Boiler station ("short proximate" analysis to include BTU/lb., moisture, ash and sulfur content). The number of "short proximate analysis" tests performed shall be at the sole

discretion of the Buyer, and the total costs of such testing shall be born by the Buyer.

7.3 Acceptance or Rejection. In the event Buyer determines the Biomass Fuel to be non-conforming, Buyer, in its sole discretion, may:

Accept the Biomass Fuel whereupon Buyer is entitled to an adjustment to the Base Price in an amount agreed upon by Parties.

Reject the non-conforming Biomass Fuel whereupon Seller shall deliver conforming Biomass Fuel within ten (10) working days. Within twenty four (24) hours of rejection, Seller shall instruct Buyer to:

Return non-conforming Biomass Fuel to Seller; or
Divert the non-conforming Biomass Fuel to Seller's designee. Any costs associated with the delivery, return or diversion of the non-conforming Biomass Fuel shall be borne by Seller.

7.4 Right to Cover. In the event that Seller fails to provide conforming Biomass Fuel within ten (10) working days of the notice of rejection, Buyer may, but shall not be required to purchase an equivalent amount from another supplier. Any Biomass Fuel purchased pursuant to this paragraph shall be subtracted from the Annual Quantity set fort in Section 5.1 as may be adjusted in accordance with this Agreement.

7.5 Suspension of Performance for Non-Conforming Biomass Fuel. If the Biomass Fuel delivered hereunder averages, over a thirty-day period, as shown by sampling and analysis made in conformity with the provisions of Section 8.2 (Sampling and Analysis), not within the limits set forth in Section 7.1 (Quality), or if any two (2) separate day shipments made during any thirty (30) day period are not within the Specification limits set forth in Section 7.1 (Quality), Buyer shall have the right to suspend deliveries under this Agreement until Seller demonstrates to the reasonable satisfaction of Buyer in writing that the deviations from specifications set forth in 7.1 have been corrected. In the event that Seller, within ten (10) working days of notification of the second non-conforming shipment, is unable to demonstrate to the reasonable satisfaction of Buyer his ability to provide conforming Biomass Fuel, then such failure shall be considered to be a material breach of this Agreement which shall entitle, but not require, Buyer to terminate as set forth in Section 18. A waiver of this right during any period by Buyer shall not constitute a waiver for subsequent periods. If Seller provides such assurances to Buyer's reasonable satisfaction, shipments hereunder shall resume and any tonnage deficiencies resulting from suspension may be made up at Buyer's sole option. Buyer shall not unreasonably withhold its acceptance of Seller's assurances, or delay the resumption of shipments. If

Seller, after such assurances, fails to provide conforming Biomass Fuel for either a thirty (30) day weighted average period or two (2) separate day shipments made during any thirty (30) day period for the next six (6) month period following resumption of shipments, then such failure shall constitute a material default of this Agreement.

7.6 Equipment Problems. In the event Buyer experiences equipment problems or other difficulties in burning the Biomass Fuel, or determines through subsequent random sampling that previously accepted Biomass Fuel (Delivery As Received) does not meet specifications and such non-conforming Biomass Fuel is found in significant quantities, Buyer shall give prompt notice of such discovery to Seller and shall have the right to halt shipments until the Biomass Fuel complies with the terms of this Agreement.

SECTION 8. WEIGHTS, SAMPLING, AND ANALYSIS

8.1 Method A. Weights. All costs associated with weighing the Biomass Fuel shall be borne by Buyer. The weight of the Biomass Fuel sold and delivered hereunder shall be determined from (a) Buyer's scales or scales approved by Buyer. Any scale used to measure the Biomass Fuel shall be maintained and operated in accordance with procedures acceptable to Seller and shall be professionally certified at intervals of no less than six (6) months to be in conformity with the most current, industry accepted Scale Handbook. Buyer shall give immediate notice by telephone to Seller if Buyer's weighing become inoperative or are discovered to be inaccurate. (b) Buyer’s volume scale weight estimate form (VSWE Form) used for measuring cord volume where an estimate of % moisture content and density of cord volume is agreed upon. In the absence of scale weights or VSWE Form from Buyer, Buyer and Seller will mutually agree upon the means of determining the weight of the Biomass Fuel sold, delivered and purchased hereunder. Such methods as may be mutually agreed upon shall not necessarily be the same as required under the tariff for payment of freight.

A net weight will be determined and reported to Seller for each shipment of Biomass Fuel hereunder. The aggregate net weights determined during any payment period shall be accepted as the quantity of biomass fuel sold and purchased during such period for which invoices are to be rendered and payment to be made.

Seller shall have the right to have a representative present at any and all times to observe the determination of weights. If Seller should at any time question the accuracy of the weights, Seller shall so advise Buyer and Buyer shall permit Seller's representative to test Buyer's weighing devices or methods. In the event Buyer's weighing devices or methods are determined to be in

error, within thirty (30) days thereafter, Buyer shall advise Seller of the amount and the estimated duration of the error. Buyer shall make adjustments to the affected invoices so that the weight is paid by Buyer as if there had been no error in Buyer's weighing devices. In the event Buyer cannot establish the amount and duration of the error, the Parties shall determine the number of tons and average BTU content of each shipment invoiced during the last half of the period since the most recent calibration of the weighing device. Should the Parties be unable to agree on this determination, it shall be resolved in accordance with Section 17.

8.2 Sampling and Analysis. Buyer shall sample and analyze, or cause to be analyzed Biomass Fuel delivered hereunder in accordance with the applicable standards of the American Society of Testing Materials (ASTM) or its successor organization. These tests shall include, but not be limited to:

Test	Test Number
Sampling	
Preparation	
Total Moisture	ASTM D 2013
Total Ash	ASTM D 5142
Heat Of Combustion	ASTM D 5865
Volatile Matter	
Total Sulfur	ASTM D 4239

8.3 Lab Testing Performed by Outside Independent Laboratory: During the complete term of this Agreement, Buyer and Seller shall agree to cost share in up to twelve (12) full proximate analyses performed by an Outside Independent Laboratory, during any twelve (12) month period. The "Full Proximate Analysis" (performed on a dry and as received basis) may include, but not be limited to, the determination of carbon, hydrogen, sulfur, nitrogen, and ash. All costs associated with the Full Proximate Analysis shall be shared equally between the Parties (50% by Buyer, and 50% by Seller). Scheduling and administration of Outside Laboratory Testing shall be the responsibility of Buyer.

8.4 Lab Testing Performed at Boiler station: To assist Seller in determining compliance with the terms of this Agreement, Buyer shall perform a "short proximate analysis" of the Biomass Fuel, on As Received Deliveries chosen at the sole discretion of Buyer. The "short proximate analysis" may include, but not be limited to, BTU/lb., moisture, and ash. Buyer shall agree that all costs associated in performing all short proximate analysis for Biomass Fuel at the Boiler station shall be born by Buyer.

8.5 Method B. Volume. Cord wood volume is based on the cube volume described as 4’x4’x8’ dry weight. Sections 8.1 to 8.4 talk about the calibration

for weight measurement. However, initial biomass fuel delivery will most likely take a form of volume measurement and assumptions on weight. The following sections will describe the volume and weight measurement that may be used for this contract if a suitable weight scale is not made available.

8.6 Cord Volume. Given the described volume for a cord of wood shown in Section 8.5, there are several methods that could be used to practically measure cord volume. Generally, one practical method to be used would be to construct a “bin” to hold and measure the desired volume of woody biomass material. One or more bins could be constructed. Volume of a bin would need to be constructed to take in consideration wood volume and unfilled “void” volume. Void volume would be the area within a cord of wood that does not contain wood volume and related weight. To compensate for void space in bin measured wood volume, testing weights to proportional constructed bin volume would need to occur.

8.7 Cord Volume Weights. Given that woody biomass weights are determined on dry weight and that harvested woody biomass fuel will have a certain amount of moisture content. Weights are first recognized in Section 7. Quality, of this agreement. The section describes an agreed upon sale weight to volume will need to be determined. For example, green Sitka Spruce has a moisture range of 45-55% water content. Dry weight is determined, theoretically on 0% moisture content. However, for field measurement purposes a Green Basis measurement may be more practical, see Figure 1.

Figure 1.
http://dnr.wi.gov/topic/ForestBusinesses/documents/BiomassMoistureContent.pdf

The basis on which moisture content % is determined (i.e. MC as a % of what?)
There are two common ways in which the moisture content percentage (MC%) of wood is routinely expressed.

GREEN BASIS: In the green or wet basis (usually abbreviated
"Green basis") method, the percent moisture in the wood is expressed as a percentage of the TOTAL weight of the wood, including both the dry wood material and the water. This method is most commonly used for pulp chips and hogged fuel and **this method is generally the method used to determine the MC of woody biomass**. It is computed as follows:

MC% (Green basis) = (weight of water/ (weight of water + dry weight of wood))*100

OVENDRY BASIS: In the ovendry basis (usually abbreviated "OD basis") method, the % moisture in the wood is expressed as a percentage of the dry weight of wood. This method is the standard method used in this country to express moisture content for solid wood products of all kinds including lumber, veneer, plywood, OSB, particleboard and other panel products.

MC % (OD basis) = (weight of water/ dry weight of wood)*100

In terms of an example, assume you have taken a sample of woody biomass equal to 100 grams in total weight, and you are able to determine that the sample consists of 49 grams of dry woody biomass material (after water equal to 51 grams is removed), the moisture contents would be calculated as follows:

MC% (Green basis) = (51/100)*100 = 51% MC (green basis)

And, for THE SAME SAMPLE:

MC% (OD basis) = (51/49)*100 = 104% MC (OD basis)

8.8 Cord Volume Weights Agreement. Given the discussion in Sections 8.6 and 8.7 regarding weight and volume for woody biomass fuel, a field determination of volume and weights would need to be assessed each purchase. Therefore, Buyer and Seller would need to agree on a weight to volume measurement to determine an agreed upon value for purchase transactions. An initial test would need to occur for each "bin" developed or change in fuel source such as green tree weight volume compared to wind thrown tree weight volume. An agreed upon field test would need to be developed where any "bin" constructed would test one or more bin loads testing for weight and volume. Once an average weight and moisture content compared to volume are determined such measurements could be assessed to a bin measurement. Furthermore, Buyer and Seller may elect to conduct a test measurement and may do so upon request of the other party. Any such test conducted would record the results in writing and be sent to both Buyer and Seller after each test. Each sale transaction will also include a written record of the determined volume and weight, including assumptions used is such estimates.

SECTION 9: PRICE

9.1 Avoided Cost Base Price: The

current Contract Year's Avoided Cost Base Price of Biomass Fuel shall be calculated by using the following formula basis of the rolling four (4) year average, when available, of the weighted average burner tip fossil fuel costs for the Boiler station: May not need this determination.

(a.) Burner Tip Fossil Fuel Cost: Shall mean the actual yearly dollar cost (stated in a cost per MMBTUs), of diesel fuel oil and propane used for the Boiler station. Burner Tip Fossil Fuel Cost shall be calculated by using FERC Form 1 (or equivalent) information for:

1. FOB Fossil Fuel Purchases.
2. Transportation Costs
3. SO2 Emission Trading Allowance Cost
4. NOx Emission Trading Allowance Cost
5. Diesel fuel and propane Handling Costs of $____ per MMBTU

(b) Fuel Mix Used In Calculating Weighted Avoided Costs: Buyer represents to Seller that a significant increase in the use (from current practices at the time of this Agreement) of diesel fuel at the Boiler station is being considered, which may affect the Buyer's perspective of avoided cost.

1. If in any Contract Year, the Boiler station's input MMBTUs of diesel fuel **exceeds** ___% of total input MMBTUs, the Fuel Mix Ratio for calculating the Avoided Cost Base Price for Biomass Fuel shall be:

Fossil Fuel Type:	Boiler station Fuel Mix
Diesel Fuel	100%
Propane	0%
Total	100%

2. If in any calendar year, the Boiler station's input MMBTUs of Diesel fuel is **less than** ___% of total input MMBTUs, the Fuel Mix Ratio for calculating the Avoided Cost Base Price For Biomass Fuel shall be the actual input MMBTUs Fossil Fuel Mix (stated in percentages for diesel fuel, and propane; the sum of which must equal 100%).

(c.) Calculation Of Avoided Cost Base Price: The current Contract Year's Avoided Cost Base Price for Biomass Fuel shall be calculated by taking the simple mathematical average of the most recent four (4) year values of Burner Tip Fossil Fuel Cost (as contained in Section 9.1(a) of this Agreement) times the Avoided Cost Fuel Mix Ratio (as contained in Section 9.1(b) of this Agreement).

(d.) Minimum Value Of Avoided Cost Base Price: If in any year of this Agreement, the calculated Avoided Cost Base Price for Biomass Fuel (as defined in Section 9.1(c) of this Agreement) is below $_____ per

MMBTU, the Avoided Cost Base Price shall be adjusted to $_____ per MMBTU.

(e.) Inflation Adjustment: The Minimum Value Of Avoided Cost Base Price for the current Contract Year, shall be adjusted yearly**, on a cumulative basis**, by an inflation adjustment using the Gross National Product (GNP) Price Deflator, as published in the Federal Register.

9.2 Economic Value Cost Sharing: Buyer and Seller recognize that there may be additional economic benefits for the use of Biomass Fuel at the Boiler station, in addition to the avoided costs of fossil fuel use. ONLY for electrical generation would this section apply.

(A.) These economic benefits may include, but not be limited to:

1. REPI Credits (a value of $1.5 per MMBTU, indexed each year for inflation), which may be available through the use of both biomass waste streams as well as "closed loop" biomass.
2. A premium paid for PG Village Council Electric's retail customers for the purchase of Heat produced from a renewable energy fuel source.
   (a.) The City of PG Village Council has conducted a Survey of its residential electric customers, where approximately 15% responded that they would be willing to pay a premium of between five (5) and ten (10) percent for Green Energy above the current total price of heat charged by PG Village Council Electric.
   (b.) PG Village Council Electric's average cost per KWH to residential electric customers for the quarter ending December 31st, 1999 was 8.85 cents per KWH (per FERC Form 1 data).
3. The Avoided Cost of other Renewable Energy options (i.e., wind, solar, hydro) in achieving minimum Renewable Energy Portfolio Standards, as are currently being proposed with Federal Heat Deregulation Legislation.
4. Selling Heat (KWH) produced from the Biomass Fuel, and/or Capacity (KW) using Biomass Fuel to Wholesale Energy Markets at a premium price. This may include selling capacity from the Boiler Station under a Unit Power Sale (UPS) Agreement to an Electric Utility, where the purchasing Utility takes a Tax Credit for using Green Energy Sources (i.e., the Section 45 Income Tax Credit), and PG Village Council Electric forgoes any claim for REPI Credits.
5. Potential Carbon Taxes on Fossil Fuels.
6. Voluntary actions to reduce Green-house gas emissions.

(B.) In order to facilitate the production and use of Biomass Fuel as a renewable energy fuel source, Buyer agrees to develop, in good faith but using the Buyer's sole judgment, a Report of the yearly economic benefits as defined in Section 9.2 (A.) of this Agreement.

(C.) Buyer also warrants to establish an Incentive Monetary Reserve Fund (the "Incentive Fund") to share with Seller and other Sellers of Biomass Fuel to the Generating Facility, in an amount equal to ____% of the calculated economic benefits as defined in Section 9.2(B.) of this Agreement.

(D.) Buyer warrants to Seller that the Incentive Fund shall be liquidated each year with payments to Seller and other Sellers of Biomass Fuel to the Generating Facility based on the formula of:
Total Dollar Value of the Incentive Fund
Divided by Biomass Fuel MMBTUs delivered to the Generating Facility.

(E.) Buyer's Incentive Fund Payments to Seller would be based on the quotient derived in Section 9.2(D.) (Incentive Fund Dollars/MMBTU), times the MMBTUs delivered by the Seller to the Generating Facility in the corresponding Incentive Fund year.

9.3 Minimum Value Of Economic Value Cost Sharing: Buyer agrees that the minimum value of the Economic Value Cost Sharing shall be $_____ per MMBTU of Biomass Fuel delivered to the Boiler station.

9.4 Total Base Price: The Total Price paid by the Buyer to Seller per MMBTU for acceptable Biomass Fuel (as defined in 8 of this Agreement) shall be the: additive total of:
1. The Avoided Cost Base Price (as defined in Section 9.1), **plus**,
2. The Economic Value Cost Sharing (as defined in Section 9.2),
3. **Equals**, The Total Base Price per MMBTU.

9.5 Quality Price Adjustments. The Total Base Price as stated in Section 9.4 is applicable to Biomass Fuel conforming to the Guaranteed Specifications on an As Received basis. Quality Price Adjustments (premiums and penalties) shall be imposed to reflect variances from the Guaranteed Specifications and shall be determined as set forth below:

By methods generally accepted in the industry, as soon as is practicable following the end of each month, Buyer shall determine and report to Seller:
1. The weighted average heating value (heating value) expressed in BTU per pound.
2. Weighted average ash content (ash content) expressed as a percentage.

The Total Base Price shall be adjusted in accordance with the procedure set forth in Section 9.4.

9.5.1 Heating Value Adjustment
The Total Base Price in effect at the time of the calculations shall be increased or decreased to compensate for variations in heating value. If the weighted

average heating value of the Biomass Fuel shipped by Seller in any calendar month is greater than one hundred (100) BTUs per pound in excess of the heating value specified in the Guaranteed Specification, the Total Base Price in effect at the time will be adjusted in accordance with the following formula:

Weighted Average BTU X Total Base Price = Heating Value Adjusted
Guaranteed BTU Base Price.

In the event the weighted average heating value of the Biomass Fuel shipped by Seller in any calendar month is greater than one hundred (100) BTUs per pound below the Guaranteed Specification, then the Total Base Price in effect at the time will be adjusted in accordance with the following formula:

Weighted Average BTU X Total Base Price = Heating Value Adjusted
Guaranteed BTU Base Price.

9.5.2 Ash Content Adjustment

The Total Base Price in effect at the time of the calculation shall be reduced if the monthly weighted average percent of ash is greater than one hundred and ____ (___) percent of the ___% ash guarantee set forth in Section 7.1 The Total Base Price reduction shall be $____ per MMBTU. The Total Base Price in effect at the time will be adjusted for any calendar month in accordance with the following formula:

($.__ per MMBTU X monthly weighted ash % minus Guaranteed Ash %) = Total Base Price Reduction.

9.5 Government Regulations Affecting Price: The Total Base Price is inclusive of all Federal, State, Community and local taxes, fees and costs of any kind, whether arising from a government law, rule, regulation or otherwise. The Parties acknowledge that during the term of this Agreement, there may occur changes in presently applicable statutes, administrative regulations and rulings, and local ordinances or the different application or interpretation thereof, not in existence at the time of execution of this Agreement. Upon such imposition of a change in any Government Regulation effecting costs, Seller shall notify Buyer of the imposition and the effect on the Total Base Price. Seller shall propose a Total Base Price adjusted for that imposition, and Buyer agrees to negotiate in good faith in adjusting the Total Base Price for the increased cost that would be incurred. In the event the Parties are unable to reach an agreement within sixty (60) days, the dispute shall be resolved in accordance with Section 17 of this Agreement.

SECTION 10: CROP ESTABLISHMENT COSTS

10.1 This section was previously written to assume Seller is only using fuel source property for the purpose of developing woody biomass fuel. Biomass crops are generally managed for short rotations. However, Seller and Buyer recognizes that Seller generally manages is forest lands for multiple use of the land and its forest products. This section may be modified in part or its entirety to better describe the commitment to the reestablishment of crop lands used for woody biomass fuel source in this agreement.

10.2 Each Party acknowledges that they have performed reasonable due diligence on the "Estimated Costs" associated with establishing and maintaining the Biomass Fuel Property until first harvest (as determined and defined in Appendix A and B of this Agreement), and that these estimates are acceptable.

10.2 Both Parties mutually agree that any and all Promissory Demand Notes (Appendix C of this Agreement) executed prior to this Agreement for compensation from PG Village Council to PG Village Corporation for the establishment and management of the Biomass Fuel Property, shall be cancelled in full, and replaced by terms and conditions contained herein:

Commencing with the date of the first commercial harvest of each Energy Crop Plantation, Buyer agrees to make payments to Seller in an amount up to 50% of the Energy Crop Plantation's "Establishment Cost" under the following terms and conditions:

1. Upon execution of this Agreement, Seller shall provide Buyer with a first lien against any and all economic benefits associated with any use, sale or transfer of the commercial value of the crop value of the Energy Crop Plantation by the Seller to a Third Party (i.e., selling the biomass crop as mulch).
2. It shall be understood by both Parties, that any and all gross proceeds, receipts, or implied market value gained from the use, sale or transfer of the crop value of the Energy Crop Plantation, other than for the economic benefit of the Buyer, will first go to reduce, dollar for dollar, the Buyer's financial obligation to compensate Seller for 50% of the Energy Crop Plantation's Establishment Cost ("Net Establishment Costs").
3. Any and all proceeds (as defined in Section 10.2.1) in the amount greater than Buyer's contractual obligation to compensate Seller for 50% of the Plantation Establishment Costs, shall be for the account of the Seller.
4. Upon the first commercial harvest date of a specific Biomass Fuel Property, Seller shall invoice Buyer for 50% of the "Net Establishment Costs" associated with the specific Biomass Fuel Property harvested.
5. During the term of this Agreement, the aggregate amount of total payments made by Buyer to Seller for Biomass Fuel Properties' "Establishment Costs" shall not exceed $_____. 10.3 Buyer

acknowledges that Seller shall use this Agreement, and specifically terms of Section 10.2 of this Agreement, to procure debt financing for the establishment, planting, and monitoring of the Energy Crop Plantation.

10.4 Insurance: Seller shall obtain and keep in force Insurance coverage for the Biomass Fuel Property during the term of this Agreement. Covered insurable events shall include, but not be limited to, drought, fire, wind, flood, insect pests, and freeze. Seller shall provide an executed copy of Insurance coverage and any and all amendments, extensions, etc., to Buyer, as contained in Appendix D of this Agreement.

SECTION 11: INVOICES, BILLING AND PAYMENT

11.0 Invoice Procedures for Biomass Fuel Shipments: By no later than the 15th day of the following month, Seller shall invoice Buyer at the Total Base Price in effect on the last day of the calendar month for all Biomass Fuel delivered in that calendar month. Invoices shall be in a form satisfactory to Buyer and be of sufficient detail to provide Buyer all reasonable information necessary to confirm their accuracy. Payment of each invoice shall be made by bank electronic wire transfer payable to Seller within thirty (30) days after receipt of invoice, unless otherwise provided for in this Agreement. Payments due to Seller that are not wired transferred within thirty (30) days of receipt of the invoice shall include a late payment fee equal to 00.03288 %, (12% per annum), per day, beyond thirty (30) days.

11.1 Retainage. Buyer shall have the right to withhold from payment any invoice or portion thereof which Buyer, in its good faith, disputes. In the event Buyer elects to exercise its rights under this section, Buyer shall notify Seller as soon as possible of such election but not later than the due date of the payment, notify Seller of its intent to withhold payment and detail the amount and basis of any dispute. Thereafter, the Parties shall engage in good faith negotiations in an effort to resolve the dispute. In the event the Parties are unable to reach an agreement within sixty (60) days, the dispute shall be resolved in accordance with Section 16 of this Agreement.

SECTION 12: FORCE MAJEURE

12.1 Events of Force Majeure. If because of Force Majeure or Environmental Force Majeure either Party is unable, in whole or in part, to carry out any of its obligations under this Agreement, and if such Party promptly gives notice to the other Party of such Force Majeure or Environmental Force Majeure, then the obligations of the Party giving such notice are suspended to the extent and for the period made reasonably necessary by such Force Majeure or Environmental Force Majeure; provided, however, that the notifying Party proceeds with all reasonable dispatch to employ such diligence as is reasonably necessary to remedy the event causing such Force Majeure or

Environmental Force Majeure.

As used herein, "Force Majeure" shall mean any event or cause beyond the reasonable control of a Party that cannot be prevented or eliminated by the exercise of due diligence including but not limited to acts of God, strike, lockout or other labor dispute, sabotage, fire, storm, freeze, wind, flood, excessive rainfall, pest insect damage, drought, war, riot or insurrection, explosion, accident, embargo, blockade, inability to secure supplies, fuel, governmental authorization or permit, unscheduled or forced outages at the Boiler Station, breakdown of or damage to machinery, plants or equipment, not the fault of the Party claiming under the Section, interruption or shortage of transportation arrangements or equipment, regulation, rule, law, order, act or restraint of any civil or military authority, or any other cause whether of the kind herein enumerated or otherwise.

As used herein, "Environmental Force Majeure" shall mean any law, regulation, policy, or restriction enacted by any regulatory body having jurisdiction or any court decision having a similar effect relating to air pollution or other environmental matters which make it impossible or commercially impractical for Buyer to utilize Biomass Fuel delivered under this Agreement or like kind and quality Biomass Fuel.

In determining whether Buyer's continued performance is commercially impractical, the terms shall mean that if production following Environmental Force Majeure would result in a total cost to Buyer in using Seller's Biomass Fuel (including the cost of any equipment amortized over its useful life), in excess of the total cost of using purchased power from other Renewable Energy Sources and/or competitive Renewable Energy Fuel and/or Generation Sources. The cost of using such Renewable Energy sources over the remainder of the term of this Agreement, including anticipated increases in the price of such Renewable Energy Sources and of any required modifications, adjustments, or additions to Buyer's Boiler Station shall be considered for the purpose of this Section.

12.2 Suspension of Performance for Force Majeure or Environmental Force Majeure. If a condition of Force Majeure or Environmental Force Majeure occurs, the mutual obligations of both Parties arising out of the event of Force Majeure or Environmental Force Majeure shall be suspended to the extent caused by the event. Should the condition of Force Majeure or Environmental Force Majeure continue for a period of six (6) months following notice by the Party of the event, then Party may terminate this Agreement under terms and conditions contained in Section 12.3 of this Agreement.

In the event that Seller is prevented in whole or in part from delivery of Biomass Fuel due to Force Majeure, the Annual Quantity set forth in Section

5.1 shall be adjusted by such amount, or at Buyer's election, may be added to future shipments pursuant to a reasonable schedule of additional shipments during the term of this Agreement.

In the event that Buyer is prevented in whole or in part from accepting delivery of Biomass Fuel due to Force Majeure or Environmental Force Majeure, Buyer and Seller may mutually agree to "Quantity Adjustments" to:

(a.) Reduce the Annual Quantity set forth in Section 5.1, or
(b.) Increase the Annual Quantity of future Deliveries during the term of this Agreement.

Under circumstances where Buyer and Seller can not mutually agree to Quantity Adjustments resulting from Force Majeure or Environmental Force Majeure of the Buyer, the Annual Quantity set forth in Section 5.1 shall remain in force.

During any period of Force Majeure or Environmental Force Majeure, Buyer shall be entitled to purchase Biomass Fuel not delivered hereunder from other Biomass Crop Suppliers and Seller shall be entitle to sell any Biomass Fuel not delivered hereunder to other customers, each without liability to the other; provided however, that such sales by Seller shall not infringe or materially alter Seller's ability to otherwise perform under the terms of this Agreement, or to perform upon the elimination of the condition of Force Majeure.

12. 3 Termination Under Force Majeure: If as a result of the adoption of such laws, regulations, policies, or restrictions, or change in the interpretation or enforcement thereof, Buyer decides that it will be impossible or commercially impractical for Buyer to utilize such Biomass Fuel, Buyer shall so notify Seller, and thereupon Buyer and Seller shall promptly consider whether corrective actions can be taken in the preparation of the Biomass Fuel and/or in the handling and utilization of the Biomass Fuel at Buyer's Fuel Source Yard or Boiler station; and if in Buyer's judgment such actions will not, without unreasonable expense to Buyer, make it possible and commercially practical for Buyer to so utilize Biomass Fuel which thereafter would be delivered hereunder without violating any applicable law, regulation, policy or order, Buyer shall have the right, upon the later of sixty (60) days notice to Seller or the effective date of such restriction, to terminate this Agreement by making payment to Seller in an amount equal to the mathematical sum of:

(1.) The Total Amount of "Establishment Costs" incurred by PG Village Corporation as defined in Appendix B of this Agreement, **less**
(2.) The aggregate amount of total payments made by Buyer to Seller for "Establishment Costs, as defined in Section 10.2 of this Agreement.

Both Parties shall agree, that the total payments by Seller to terminate this

Agreement under Force Majeure or Environmental Force Majeure shall not exceed $_____.

Buyer's decisions and opinions with respect to this Section shall be final in its sole discretion and not subject to dispute by Seller. In the event Buyer exercises its termination right under this Section, Seller shall have the right but not the obligation to offer a like quantity and quality of Biomass Fuel that will meet the restrictions adopted. The price for such Biomass Fuel will be the market price, as determined by a Biomass Fuel solicitation, for similar Biomass Fuel at the time of the adjustment. If Seller declines or does not accept within such fifteen (15) days, this Agreement shall be terminated effective immediately.

SECTION 13: AUDIT AND INSPECTION

Buyer (or its authorized representative) shall have the right to inspect, review, and audit Seller's books with respect to methods by which Biomass Fuel is planted, grown, monitored, handled, sampled, analyzed, loaded and transported hereunder at any time during regular business hours, and upon reasonable notice to Seller. Seller shall maintain and cause it's representatives to maintain, all data and information discovered pursuant to this Section in confidence except to the extent that disclosure thereof may be required by law.

Seller shall maintain all records relating directly or indirectly to any proposed revision the Total Base Price under Sections 7 or 9.5 and shall furnish to Buyer substantiation thereof, in form and detail satisfactory to Buyer. Buyer shall have the right at all reasonable times to audit and inspect such records for a period of two (2) years following termination of this Agreement.

SECTION 14: NOTICES

14.1 Form and Place of Notice. Any official notice, request for approval or other document required to given under this Agreement shall be in writing, unless otherwise provided herein, and shall be deemed to have been sufficiently given if delivered in person, transmitted by email, telegraph, telex, or telecopier, or dispatched in the United States mail, postage prepaid, for mailing for first class, certified, or registered mail, return receipt requested and addressed as follows:

If to Seller: PG Village Corporation
629 L Street, Suite 205
Anchorage, Alaska 99501
lhs@portgrahamcorp.com

If to Buyer:

PG Village Council
P. O. Box 5509
Port Graham, Alaska 33801
pnormanvc@hotmail.com

14.2 Change of Person or Address: Either Party may change the person or address specified above upon giving notice to the other Party of such change.

15.0 RIGHT TO RESALE

Buyer shall have the unqualified right to sell all or any of the Biomass Fuel purchased under this Agreement, as long as the ultimate use of the Biomass Fuel shall be used as fuel.

16.0 INDEMITY

Seller agrees to indemnify and save harmless Buyer, its officials, officers, directors, employees and representative from any responsibility and liability for any and all claims, demands, losses (including reasonable attorney's fees at the trial and appellate level) arising out of or resulting from any acts of commission, omission, negligence or fault of Seller.

Buyer, to the extent permitted by law, agrees to indemnify and save harmless Seller, officers, directors, and employees from any responsibility and liability for any and all claims, demands, loses (including reasonable attorney's fees at the trial at appellate level) arising out of any act of omission, commission, negligence or fault of Buyer. In no event, however, shall either Party's obligation hereunder include indirect, incidental or consequential damages.

SECTION 17: DISPUTE RESOLUTION

In those instances where the Parties are required by the terms of this Agreement to negotiate a solution of a dispute, should resolution not occur within the time period set forth in the pertinent section, but in no event greater than sixty (60) days, the Parties agree that the dispute shall be resolved in accordance with procedures set for in Chapter 43, Alaska Statutes, the "Alaska Arbitration Code."

SECTION 18: TERMINATION FOR DEFAULT

Buyer shall have the right to terminate all or any portion of this Agreement upon the happening of any of the following events of default by Seller:

- The insolvency of Seller
- If Seller is adjudged bankrupt

- If a general assignment of Seller's assets is made for the benefit of creditors.
- If a receiver is appointed for Seller or any of Seller's property.
- If Seller is in violation of any governmental statute, rule or regulation with which Seller does not comply promptly following notice.
- If Seller is in default of any material provision of the Agreement.

Prior to exercising the right of termination, Buyer shall give to Seller thirty (30) days notice of its intention to terminate specifying the nature of the default. Upon expiration of thirty (30) days, unless Seller shall have cured such condition, Buyer shall have the right at its election to terminate this Agreement forthwith. This right shall be in addition to the rights provided to either Party in other portions of this Agreement or as may be provided at law or equity. In the event of the failure of Seller to comply with any material obligation of this Agreement, Buyer shall have the right to terminate this Agreement at any time by giving to the other, thirty (30) days notice in writing of its intention to do so, specifying the default considered material. At the expiration of said thirty (30) days, unless the Party in default shall have made cured such condition, the non-defaulting Party shall have the right at its election to terminate this Agreement forthwith. This right shall be in addition to the rights provided to either Party in other portions of this Agreement or as may be provided at law or equity.

SECTION 19. CONSTRUCTION OF AGREEMENT

19.1 Applicable Law. This Agreement shall be construed and interpreted in accordance with the laws of the State of Alaska; venue for any action arising out of the Agreement shall be Municipality of Anchorage, Alaska or the U.S. District Court for the District of Alaska, Anchorage Office.

19.2 Headings. The paragraph headings appearing in this Agreement are for convenience only and shall not affect the meaning or interpretation of this Agreement.

19.3 Waiver. The waiver by any either Party of any default by the other Party hereunder, or the failure of either Party to, at any time, insist upon strict performance with any of the terms and conditions of this Agreement, shall not be deemed a waiver by such Party of any default by the other which thereafter may occur or a waiver by such Party of its right to insist upon strict performance by the other Party thereafter.

19.4 Remedies Cumulative. Remedies provided under this Agreement shall be cumulative and in addition to other remedies provided by law.

19.5 Severability. If any provision of this Agreement is found contrary to law or unenforceable by any court of law, the remaining provisions shall be severable and enforceable in accordance with their terms, unless such unlawful or unenforceable provision is material to the transactions contemplated hereby, in which case the Parties shall negotiate in good faith a substitute provision.

19.6 Binding Effect. This Agreement shall bind and inure to the benefit of the Parties and their successors and assign.

19.7 Assignment. Seller shall not assign this Agreement or any rights or obligations hereunder without the prior written consent of Buyer, which consent shall not be unreasonably withheld. Buyer shall not assign this Agreement or any rights or obligations hereunder without the prior written consent of Seller, which consent shall not be unreasonably withheld.

19.8 Entire Agreement. Except as otherwise provided herein, this Agreement may not be amended, supplemented or otherwise modified except by written instrument signed by the Parties hereto.

IN WITNESS WHEREOF, the Parties hereto have caused this Agreement to be executed as of the date first above written.

Port Graham Village Council
An Alaska Native Village

By: _____

Port Graham Village Corporation
An Alaska Corporation

By: _____

Appendix A
Biomass Fuel Quantity And Delivery Determination

Both Parties agree that the following Appendix is to be used in determining the Quantity Terms and Conditions of this Agreement, as contained in Section in 5.0.

1.0 **Pre-existing Biomass Fuel Supply**: Buyer understands that at the time of the execution of this Agreement, that Seller does not have current access to Biomass Fuel Resources to meet future Quantity Requirements contained in Section 5.0.

1.1 **Biomass Plantation Establishment**: Buyer understands that in order to satisfy Section 5.0 of this Agreement, that Seller must establish Biomass Energy Crop Plantation(s) (the "Biomass Fuel Property").

1.2 **Type Of Energy Crops For Plantation**: Seller represents that Energy Crops for the Plantations shall be from two (2) agriculture sources: Eucalyptus Grandis trees, Pine trees, and Leucaena trees.

1.3 **Fuels Analysis On Energy Crops**: Prior to the execution of this Agreement, Seller shall provide Buyer with ASTM Testing of the proposed (or equivalent) Biomass Fuels, including ash, moisture, heat of combustion, carbon, hydrogen, nitrogen, chlorine, sulfur (on a dry and received basis).

1.4 **Due Diligence On Fuels Analysis On Energy Crops**: Upon execution of this Agreement, Buyer agrees that Seller has provided adequate preliminary fuels analysis data/information to Buyer (as specified in Section 1.3 of this Appendix), for the Buyer to perform sufficient due diligence on the operating characteristics of the Future Biomass Fuel Supply, specific to the Generating Unit.

1.5 **Planting And Harvesting Cycle Of Energy Crops:** Seller and Buyer agree that in determining the Plantation(s) size (in acres) to satisfy Section 5.0 of this Agreement, that the following assumptions are made:

Biomass Crop Fuel Type:	Crop Rotation Harvest Cycle	Crop Rotation For 1st Harvest	Crop Yields Per Acre Year	MMBTUs Per Green Ton
Sitka Spruce	4 Years	4 Years	50 Green Tons	7
Willow (Salix)	8 Years	8 Years	20 Green Tons	7
Cottonwood (Populus)	1 Year	2 Years	30 Green Tons	7
Crop rotations	To be	Determined.		

1.6 **Plantation Size Planting Requirements**: Seller and Buyer represent that "due diligence" has been performed by each Party to determine the required size of the Plantation(s) necessary to produce biomass fuel to satisfy the Buyer's Biomass Fuel Requirements under Section 5.0 of this Agreement. Buyer acknowledges that Seller's Members are to establish the following Biomass

Plantation(s), based on Buyer's stated intent to purchase biomass from the Plantation(s):

Biomass Crop Fuel Type:	Number Of Acres Planted	Trees Per Acre Planted	Establishment Date Range
Sitka Spruce		1,000	
Willow (Salix)			
Cottonwood (Populus)			

1.7 **Fuel Quantity**: Both Parties agree that significant uncertainty exists, which the Seller may have no control over, as to biomass crop yields and Environmental Force Majeure (as defined in Section 12 of this Agreement), including but not limited to fire, freeze, drought, and wind damage.

Buyer agrees to accept the following "as delivered" minimum yearly levels of biomass fuel, if available and offered from Seller. Buyer also agrees to hold harmless the Seller, for the inability to deliver minimum yearly biomass fuel tonnage levels caused by lower than expected crop yields or Environmental Force Majeure.

Minimum tonnage levels shall be measured on a Green Ton Basis, representing a moisture content of the biomass fuel of approximately 50 percent.

Buyer agrees to purchase and apply price compensation to Seller (as defined in Section 9 of this Agreement) for biomass fuel tonnage quantities up to the following minimum annual quantity levels, that Seller offers to deliver to Buyer. Buyer agrees that payment compensation to Seller shall be based on an obligation to either (1) take the biomass fuel if offered, or (2) pay Seller for biomass fuel offered but not accepted for delivery at the Generation Station.

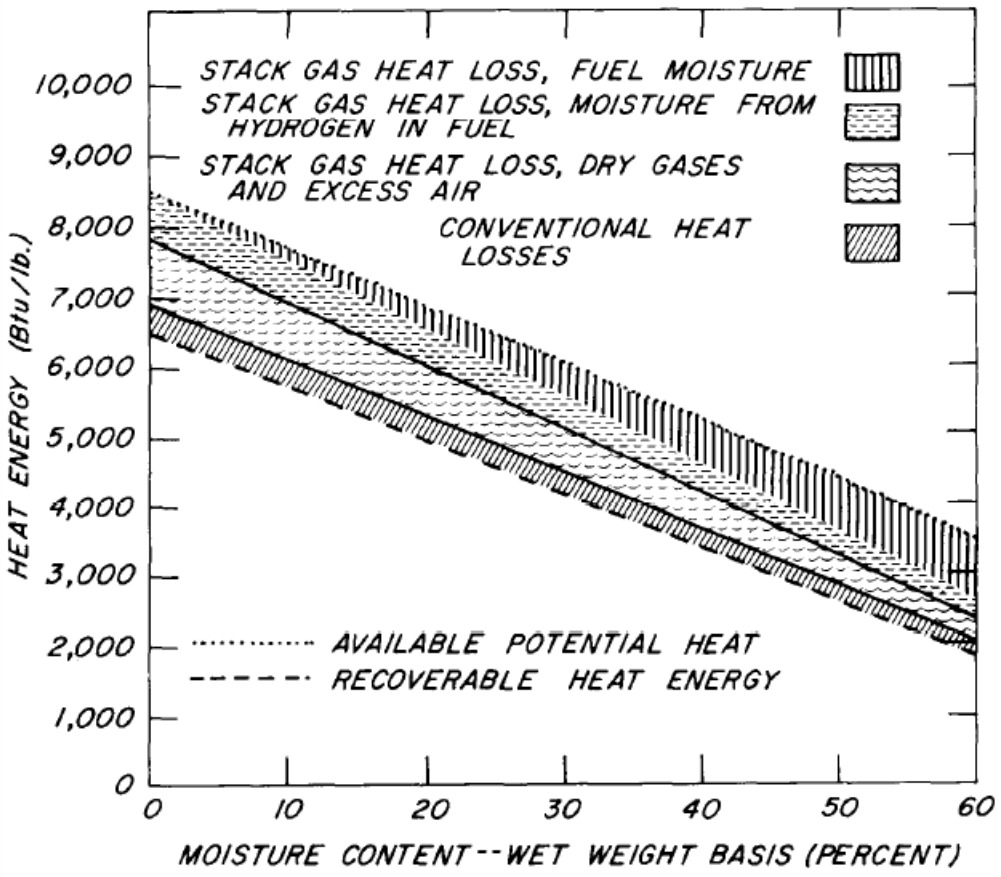
Contract Year	Sitka Spruce	Willow (Salix)		Total Tons
1	None	None	None	None
2	None	None	None	None
3		None	None	
4		None	None	
5			None	
6			None	
7			None	
8			None	
9				
10				

11				
12				

1.8 **Restrictions To Quarterly Delivery Schedule**: Buyer represents that "due diligence" has been performed, and that Buyer sufficiently understands the agriculture term of coppice -- where the biomass energy crop will re-grow after each harvest. Both Parties agree that best agricultural practices must be followed in harvesting fuel from the "Biomass Fuel Property", where to maximize coppice of the trees (i.e., future crop yields), harvesting would not occur in the following months:

Biomass Crop Fuel Type:	Agriculture Best Practices Restriction On Harvesting Month(s) To Maximize Coppice
Sitka Spruce	Does not coppice
Willow (Salix)	
Cottonwood (Populus)	

Appendix B
Biomass Fuel Quality

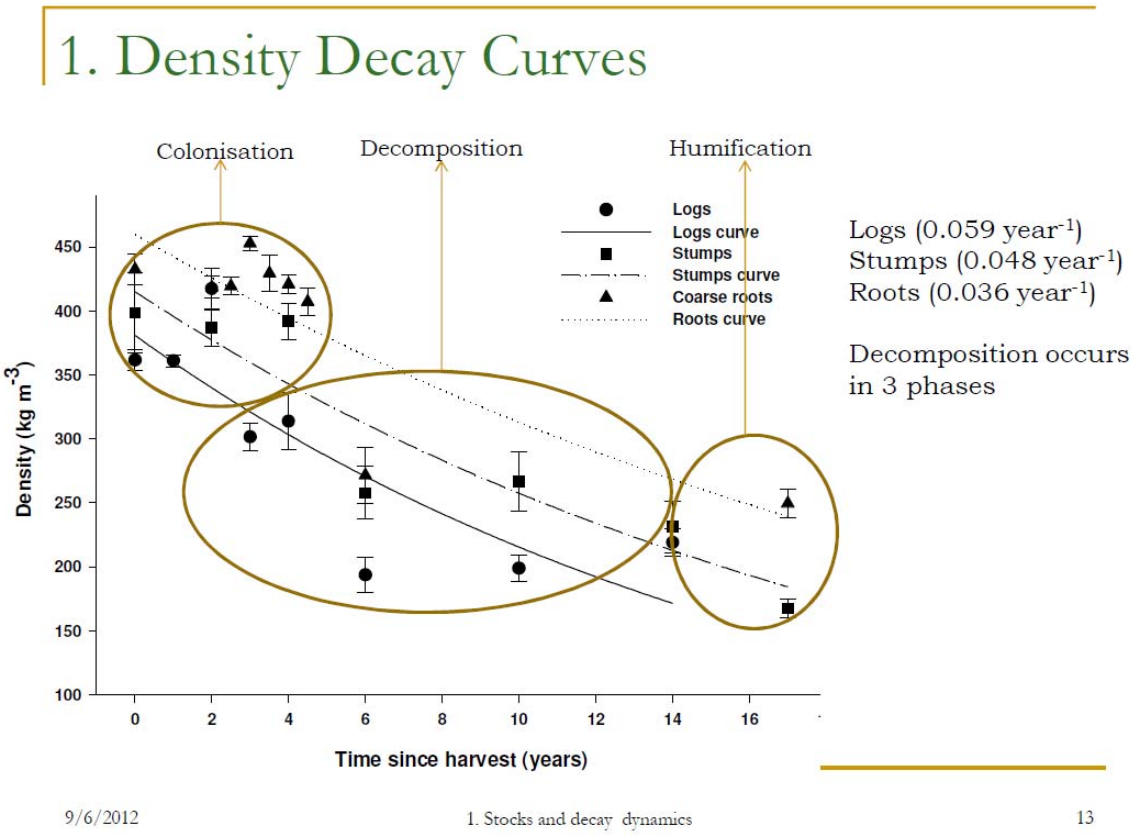


http://www.fpl.fs.fed.us/documnts/fplgtr/fplgtr29.pdf

The above graph is for reference only. It is based on moisture content by weight basis expressed as a percentage of the overall weight of woody biomass. Heat energy output expressed in Btu/pound demonstrates an almost straight line decreasing output per increasing percent moisture content.

The definition of bone dry tons is a weight of 2000 pounds with 0%[4] moisture content, which is exceedingly difficult to measure except in laboratory testing. Another measure is what is called an Air Dried ton that can vary in definition but can generally be expressed as 10%[5] moisture.

[4] http://en.termwiki.com/EN:bone-dry_ton_(BDT)
[5] https://answers.yahoo.com/question/index?qid=20090425215419AAoHkA8



The Density Decay Curves graphic of Sitka Spruce[6] is included to demonstrate the relationship of wood decay over time. Density as a function of weight of wood is what is measured.

One needs to consider weight loss of wood for this contract as wind thrown trees are a desired product for Buyer. However, consideration must be made for loss of weight of the wood depending on age of harvested wood or windthrown trees. Also quality of wood that was described in Section 7, Quality and Specification of Biomass Fuel, would need to be considered from such described decay as demonstrated in the graph.

[6] http://www.ucd.ie/carbifor/documents/SO.pdf ; http://www.sciencedirect.com/science/article/pii/S0378112711003628

Appendix C

Biomass Fuel Property Establishment Cost

Project Work Tasks And Activities:	PG Village Council Electric's Allocated Costs	Grower's Co-Op Allocated Costs	Total Biomass Fuel Property Costs
Planting Costs:			
Sitka Spruce Plantation			
Willow (Salix) Plantation			
Cottonwood (Populus) Plantation			
Total Planting Costs			
Other Costs:			
Land Rental Costs			
Insurance Costs			
Project Financing Cost			
Site Maintenance			
Laboratory Testing			
Total Other Costs			
Total Project Costs			
Allocation Of Costs	50%	50%	100%

Allocation Of Plantation Establishment Costs

Work Task & Activities	Sitka Spruce Plantation	Willow (Salix)	Cottonwood (Populus) Plantation
Planting Costs			
Other Costs			
Total Costs			
Allocation Of Costs	%	%	%

Note: One of these tables will be needed for each member of the PG Village Corporation. In addition individual landowners may opt for just one species rather than two or three.

Appendix D

Promissory Demand Note

Irrevocable Standby Letter of Credit
Date
Beneficiary: Environmental Fuels PG Village Corporation
Address

Dear Gentlemen,

We hereby establish our Irrevocable Standby Letter of Credit No. _____ in Beneficiary's favor for account of Environmental Fuels PG Village Corporation, up to the aggregate sum of US $ _____ available by payment against Beneficiary's sight Draft(s) and drawn before [expiry date], accompanied by the following document:

A written statement purportedly signed by the Beneficiary with the following wording:

" Environmental Fuels PG Village Corporation hereby certifies the amount drawn is necessary for either the establishment or maintenance of the Energy Crop Plantation Project located at [address location of Project], which is engaged in the sole purpose of growing biomass fuel crops for PG Village Council Electric."

It is a condition of the Letter of Credit that it shall be automatically extended without amendment for an additional period of one (1) year from the present or any future expiration date unless at least (30) thirty days prior to such date, we shall notify you in writing at the above address by Registered Mail or Courier Service that we elect not to renew this Letter of Credit for such additional period.

Any Draft drawn under the Credit must be marked:

> Drawn under Irrevocable Standby Letter of Credit No. _____, issued by
> _____

This Letter of Credit is subject to the 1993 Revision of the Uniform Customs and Practice for Documentary Credits of the International Chamber Of Commerce (Publication No. 500). We hereby engage with you that Drafts drawn under and in compliance with the Terms of this Credit, will be duly honored on presentation to us at our Letter of Credit Dept. [Letter of Credit Bank Address] on or before _____, the Expiration Date or any automatically extended Expiration Date.

[Issuing Bank]

By: _____
Title: _____

Appendix E

Biomass Fuel Property Insurance Policy

Copy of Draft Insurance Policy from Carden & Sprott (Agriculture Insurance Underwriters), Winter Haven, Fl. (941-291-3505).