MEMORANDUM

TO: Paul Andersson (San Juan Islands Conservation District)

FROM: Meagan Hartman (Wisewood Energy)

CC: Kai Hoffman-Krull (SJICD), Andrew Haden (Wisewood Energy)

DATE: September 10, 2021

RE: Final Summary of Biomass Microgrid CHP Technology Assessment

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Introduction

In 2020, the San Juan Islands Conservation District (SJICD) was successfully awarded a Department of Commerce Forest Products Financial Assistance Program (FPFAP) Grant with its submission of "Appropriate Technologies for Fire Mitigation, Energy Independence, and Soil Carbon in San Juan County." SJICD retained Wisewood Energy to complete Milestone B of that work, consisting of a biomass microgrid combined heat-and-power (CHP) technology assessment. This assessment builds upon longstanding efforts in land management and forest health, waste disposal, and exploration of biomass utilization in the San Juan Islands, including by SJICD, Rainshadow Consulting, Northwest Natural Resource Group (NNRG), OPALCO, and others.

The objective of Wisewood's scope of work under this project was to identify a viable biomass CHP system that would support emergency preparedness on Orcas Island that would be an outlet for residual woody material generated from forest restoration treatments and utility line clearance, and establish an on-island energy asset to supply power to critical infrastructure during outages. Utilizing locally available residual biomass as a reliable, renewable energy resource incentivizes forest management, provides a controllable enery asset for local power utilities and supports island energy independence, and helps to improve regional air quality in the San Juan Islands. This memo summarizes the results of Wisewood's analysis, and is accompanied by a presentation board intended to be a visual tool for community engagement.

Attachments include:

1. Map of Eastsound Substation Service Territory
2. Wood Fuel Volume Analysis & Block Diagram
3. Microgrid CHP Preliminary Energy & Cost Analysis
4. Microgrid CHP Preliminary Conceptual Design
5. Central Wood Processing Site Conceptual Process Flow Diagram
6. Central Wood Processing Site Preliminary Conceptual Design
7. Rough Order Magnitude of Capital Cost

Biomass CHP Technology Assessment Parameters

To determine what type of wood energy system would best meet project objectives, Wisewood assessed three key parameters for Orcas Island: 1) existing energy demand for buildings that might connect to the system; 2) available wood fuel supply; and 3) deployable biomass CHP technology.

EXISTING ENERGY DEMAND

To evaluate the opportunity for district heating and guide CHP system sizing, Wisewood Energy sought to collect both heating and electricity usage data from core community buildings that could be connected to a wood energy system. While the global pandemic slowed these efforts, Wisewood was able to collect data for OPAL Community Land Trust's April's Grove, Rainshadow Consulting office, and multiple County buildings. In addition, County and Orcas Island School District staff were consulted regarding energy usage at other critical facilities and the schools. Only limited heating data was available, with most buildings employing electric air-source heat pumps except for the Fire Hall Station, which uses a propane boiler. This lack of large thermal loads led Wisewood and project partners to focus on power generation scenarios, with thermal energy as a secondary product where possible.

To establish the existing demand for electricity at the community level, Wisewood collected kWh interval data from OPALCO for the Eastsound substation, which serves a strip of Orcas Island from the community of Eastsound to the northern edge of the island (see Attachment 1 for the substation service territory). This data represents the largest existing load that could be targeted for a biomass CHP system. Additionally, Wisewood was able to collect annual electricity data from the Orcas Ferry Landing, Senior Center, Sheriff's Office, San Juan County Public Works, and Orcas Island Fire & Rescue, which were used to represent typical electricity loads for critical facilities in the County. These electricity loads are shown in Table 1, below.

TABLE 1 Electricity usage data for the OPALCO Eastsound Substation and buildings, considered representative of critical infrastructure on Orcas Island.

FACILITY	kWh/YR	NOTES
EASTSOUND SUBSTATION	37,400,000	3 years of grid data
SHERIFF + PUBLIC WORKS	37,200	1 year of electricity consumption data
ORCAS ISLAND FIRE & RESCUE	87,000	1 year of electricity consumption data
SENIOR CENTER	56,200	1 year of electricity consumption data
ORCAS FERRY LANDING	14,200	1 year of electricity consumption data

WOOD FUEL SUPPLY AVAILABILITY

The volume and type of available woody material is a key factor in determining appropriate biomass energy technology options, because this provides a ceiling for how much fuel demand is sustainable for the area. Through consultation with local land managers, Wisewood identified seven likely sources of biomass fuel on Orcas Island and estimated both the current and potential volume that could be accessible for a wood energy system, assuming a portion of material is left on-site in each case. A summary of these fuel estimates is shown in Table 2, below. Some sources, such as forestry/PCT and utility line clearance, may increase more dramatically than current estimates show if a biomass system is established as an outlet for wood residuals,

while others, such as logging slash, are likely to fluctuate based on other factors such as market conditions. See Attachment 2 for a more detailed wood fuel volume analysis and conceptual block diagram.

In addition to the preliminary assessment completed by Wisewood Energy, NNRG is conducting an ongoing county-wide biomass assessment based on empirical estimation of the amount of available residual material from thinning treatments on the islands. Preliminary estimates suggest between 5 and 14 bone dry tons (BDT) per acre would be generated from pre-commercial thinning (PCT) treatments on Orcas Island, and 10 and 18 BDT/acre across all San Juan County islands. Wood fuel supply estimates should be considered preliminary, to be refined during additional analysis.

TABLE 2 Wood fuel sources identified on Orcas Island, including notes and estimated current and future availability in bone dry tons per year. In each case, a portion of material is estimated to be left on-site or otherwise unavailable for a wood energy system. Note the accompanying block diagram shows wood fuel availability in green tons.

BIOMASS SOURCE	NOTES	EST. CURRENT AVAILABILITY (BDT/YEAR)	EST. FUTURE AVAILABILITY (BDT/YEAR)
RESIDENTIAL/COMMERCIAL TREE SERVICE AND LANDSCAPING	- Byproduct of tree service and landscaping - Currently chips are either left on-site or hauled to Rainshadow for sale	144	173
FORESTRY/PRE-COMMERCIAL THINNING & FUEL REDUCTION	- Currently mixed treatment, some scattered and left on-site, some piled and burned - Volume is likely to increase the most with new market, encouraging more forest health management - Can be logistic challenges with retrieval	503	1,005
LOGGING SLASH	- Slash piled at landings from commercial forestry - Up to 8-10" diameter, not sorted - Very market driven means lumpy availability	1,632	1,877
SAWMILL OVERS	- Dispersed operations - Difficult to estimate volumes - Likely an underestimate; need more data	21	27
LAND CLEARING & DEVELOPMENT	- Root wads etc. from development, currently taken to landfill for a fee	1,116	1,674
UTILITY LINE CLEARANCE	- Often left on-site for property owners or in forest - Potential diversion for biochar and energy production	275	480
COMMUNITY DROP-OFF/ORS WASTE WOOD	- Unsorted clean lumber, branches, windfall, gardening, etc. currently dropped at Orcas Exchange for a high fee	57	114
	TOTAL EST. AVAILABILITY (BDT/YEAR)	**3,748**	**5,350**

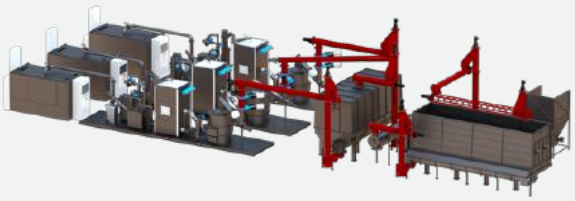
TECHNOLOGY OPTIONS

Wood energy technology has undergone significant R&D development and subsequent commercial deployment over the past three-plus decades around the world, led by European countries such as Austria, Sweden, and Germany. Modern and efficient wood boiler systems for thermal energy have dominated the wood energy industry, while similar development efforts over the last ten years have contributed to the commercial availability of biomass CHP gasification systems.

Gasifier systems convert woody biomass to commercial energy via the process of "gasification." The biomass fuel is heated in a reactor with limited oxygen, which causes the solid biomass to be converted to a fuel-rich gas (mostly CO and H2O) that is subsequently filtered of impurities, cooled and then sent to a modified natural gas engine that is coupled to an electric generator set to produce electricity and, as a byproduct, thermal energy. The main benefit of gasifier technology is its high electrical conversion efficiency; 30% power-only compared to <24% in other biomass electricity generation options, and 82% efficient with productive thermal energy use. The disadvantage of gasifiers is that they are typically more sensitive to fuel quality and therefore need more attention and maintenance than heat-only boiler systems.

Wisewood evaluated two biomass gasifier technologies for Orcas Island: Bioenergie Wegscheid (formerly HolzEnergie Wegscheid, or "Holz") out of Germany, and Syncraft out of Austria. Holz has been in business for 13 years and has over 120 units operating worldwide, equivalent to an electrical capacity of about 15MW. Syncraft was commercialized in 2014 after 7 years of careful technological development, and has roughly 13 units (about 7.3MW) in operation. Key attributes of the two systems are listed in Table 3 below, and help to guide which is best suited to a biomass system on Orcas Island.

TABLE 3 Summary of key attributes for biomass gasifiers considered for the Orcas Island system.

Holz	Syncraft
• 65kW and 125kW units • Best suited to applications <2MW • Can be installed in shipping containers for construction cost savings in remote locations • No biochar production from units (can be produced with separate equipment) 	• 500kW units • Best suited to applications 1MW-5MW • Requires two-story building and more costly construction • Requires co-production of biochar 

Energy System Analysis & Conceptual Design

Wisewood Energy used the information gathered above to model several biomass system scenarios, summarized below in Table 4. First, small 65kW or 125kW Holz systems were modeled as distributed net metering microgrids for critical facilities, based on the available county data; however, this was determined

to be unviable because a single gasifier would generate a large amount of excess electricity relative to the low individual loads of each building. Various central grid-connected CHP systems were then modeled, including those equal to or below 1MW capacity and larger than 1MW. Rather than providing energy to a single end user, a central CHP plant would supply electricity to the OPALCO grid to supplement the Eastsound substation, with thermal energy available for space and/or process heating. Microgrid controls would be added to ensure that critical infrastructure connected to the grid would continue to receive power in the event of an outage.

A 1MW central facility would generate over 30x the electricity demand estimated for the four San Juan County critical facilities combined, and almost 20% of the total Eastsound annual grid demand. The maximum modeled capacity (3MW) would generate approximately 50% of the Eastsound annual grid demand. While any of these central sizes would be a benefit to the grid system, those that are 1MW or below appear to be a better fit for the available volume of woody material estimated for the area. For this reason, Wisewood is recommending a 1MW central CHP Holz system for the Orcas Island system, described in more detail below and in Attachment 3. These recommendations may be revisited after a more detailed economic and energy optimization process, which may suggest a larger system that does not run as frequently would use a similar volume of wood fuel with a better value proposition to grid operators.

TABLE 4 Summary table of modeled scenarios relative to technology parameters.

	Distributed Microgrids	Small Central Microgrid	Medium Central Microgrid
Description	Individual gasifier units net metering at multiple critical facility sites	Single grid-connected CHP facility with microgrid controls for critical infrastructure, ≤1MW capacity	Single grid-connected CHP facility with microgrid controls for critical infrastructure, 1-3MW capacity
Electricity Output	Min. approx. 500,000 kWh/yr	900,000 - 7,500,000 kWh/yr	7,500,000 – 22,500,000 kWh/yr
Wood Fuel Demand	Approx. 500 BDT/yr	900 - 5,200 BDT/yr	5,200 – 15,300 BDT/yr
CHP Technology	Both too large	Holz best suited	Either possible for small end, Syncraft best for larger
Conclusions	Not recommended	Recommended	Not recommended

RECOMMENDED ENERGY FACILITY CONCEPTUAL DESIGN

Wisewood's conceptual design of the energy generation facility is included as Attachment 4, and includes 8 Holz gasifier units installed within a stick-built structure to showcase San Juan County as a leader in advanced wood energy systems and state-of-the-art technology. At the energy facility, wood fuel is unloaded into four fuel bays with a total capacity of approximately 1 week of storage. The fuel bays are designed with floor dryers—air systems under the floor—to bring wood chip moisture content down to the specified 10%. To load wood fuel into the 8 gasifiers, workers will manually maneuver front-end loaders within the fuel delivery truck lane to distribute chips from the fuel bay into four hoppers—the more labor-intensive option—or, alternatively, an automated fuel in-feed equiment could be installed. The four hoppers connect to a screen

and metering bin to form one fuel in-feed system, each of which feeds fuel to 2 gasifier units. The gasifier units themselves have multiple key parts, including the gasifier unit, a filter, ash extractor, gas cooler, and engine.

CENTRAL WOOD COLLECTION AND PROCESSING SITE

In addition to the central biomass CHP facility, Wisewood Energy developed a conceptual design for a central wood collection and processing site. A central location for receiving wood fuel, processing and screening as needed, and storing fuel inventory under cover will streamline operations at the energy generation site. Ideally, the central wood processing facility includes capacity to receive material that is already chipped, such as landscaping or power line maintenance residuals, as well as whole material that needs additional handling and chipping, such as household pruning or land clearing woody debris. Such a facility may ultimately be co-located with the CHP facility, but at this time was assessed as a distinct site.

Wisewood's conceptual design of this site includes an in-feed bin where dump trucks (or other vehicles able to convey wood material) deposit chipped biomass material, as well as an area where whole material can be chipped and loaded into the bin. Then, automated wood processing equipment cleans and sorts the wood chips using a magnet and shaker screen to remove fine material and any metal debris. Chips are screened for appropriate size, and conveyors send accpetable chips to storage and overs to a hammer mill for additional grinding before storage. Excess and residual woody material can be used for compost, and/or processed in a separate biochar unit to produce a valuable soil amendment. Covered storage is designed to hold sufficient fuel to operate the CHP facility for six weeks. Stored chips would be loaded into walking floor trailers via automatic fill chutes and hauled to the energy generation site as needed (if not co-located). A conceptual process flow diagram of the movement of material for the central wood processing facility is included as Attachment 5, and a conceptual design is included as Attachment 6.

PRELIMINARY COST ESTIMATES

At this stage in the project, all costs are preliminary and are expected to be further refined as the design and local factors are better defined. The cost of biomass energy is currently estimated to be between $0.05 and $0.16 per kWh; factors that contribute to a lower cost of energy include a lower cost of wood fuel, making productive use of the thermal energy, and selling other byproducts such as biochar. Wood fuel is currently estimated at $55/ton (including processing), a moderate price based on input from land managers. This price could be as low as $22/ton, assuming a $23/ton fee (equivalent to the excavator's fee), or as high as $90-110/ton with a $25-45/ton payment for biomass. The cost per ton, and the economics of a fee or payment schedule, is likely to fluctuate and is worth further investigation. Other operating cost estimates should also be confirmed through further analysis, such as the cost of waste disposal, and savings possible through co-locating the CWP and gasifier systems.

At this stage of the project, estimated capital costs are based on known major biomass equipment and so are subject to refinement as the design is further developed. Wisewood estimates capital costs for the 1MW Holz microgrid gasifier substation to be between $10M and $11.1M (manual and automated); a 1MW Syncraft system, while not evaluated in detail here, is estimated to cost approximately $13M. The central wood processing facility as currently conceptualized is estimated to cost approximately $2.9M. See Attachment 7 for more detailed rough order magnitude of capital costs.

Conclusions and Considerations

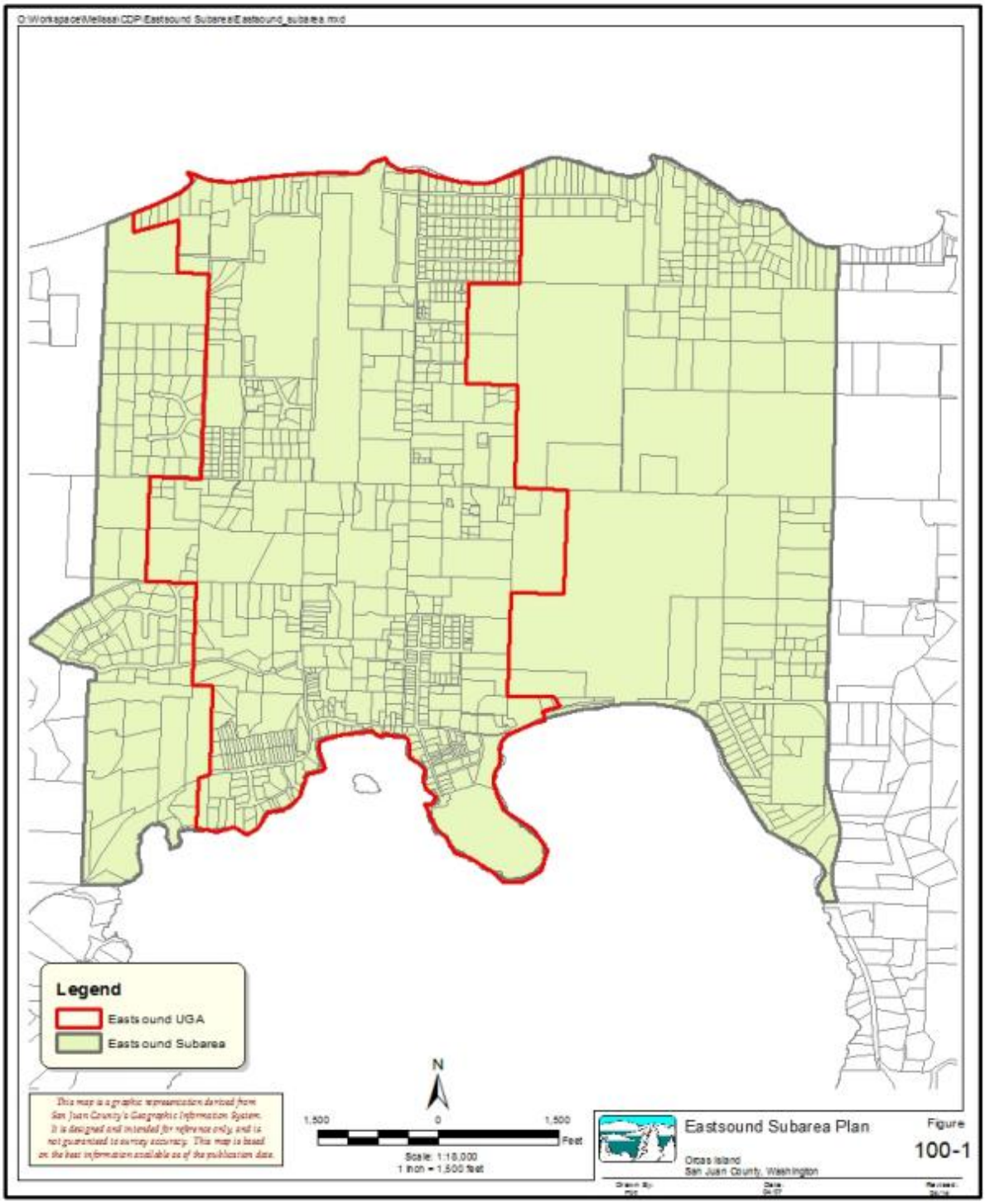
Modern wood energy is a unique renewable energy technology for its ability to operate 24/7 as a controllable asset while creating a meaningful and sustainable outlet for island wood waste. As detailed above, Wisewood recommends moving forward with a 1MW central microgrid system for Orcas Island. While this capacity only provides a portion of the total substation demand, it is estimated to be more than enough for critical infrastructure that can be prioritized for power supply during outages. At a maximum of 5,200 BDT/yr wood fuel demand, a 1MW system also appears to be a good match to the waste wood fuel supply preliminarily estimated for Orcas Island. Wisewood also recommends a central location for wood collection and processing as the key to greatest community impact, and if possible, co-locating it with the biomass CHP system.

Items that warrant further analysis include an economic optimization analysis to determine whether a different capacity system may have a similar fuel demand but higher value for the grid, a deeper assessment of material available on Orcas Island and a more precise determination of its cost, and other operating costs. These factors will impact both the capital cost of the system and the cost of energy.

With this biomass technology assessment complete, SJICD, OPALCO, and Wisewood will be moving forward on subsequent stages of design. OPALCO has been awarded two grants with funding to complete preliminary and detailed design of the system, including through the US Forest Service and Washington State's Clean Energy Fund. Next steps will include eliciting input from key community groups from this round of project analysis, energy valuation, outreach activities, and preliminary engineering.

Attachment 1

Map of Eastsound Substation Service Territory


O:\Workspace\Melissa\CDP\Eastsound Subarea\Eastsound_subarea.mxd
Legend
Eastsound UGA
Eastsound Subarea
This map is a graphic representation derived from San Juan County's Geographic Information System. It is designed and intended for reference only, and is not guaranteed to survey accuracy. This map is based on the best information available as of the publication date.
N
1,500
0
1,500
Feet
Scale: 1:18,000
1 inch = 1,500 feet
Eastsound Subarea Plan
Orcas Island
San Juan County, Washington
Figure
100-1

Attachment 2

Wood Fuel Volume Analysis & Block Diagram

San Juan Island Conservation District

Appropriate Technologies for Fire Mitigation, Energy Independence, & Soil Carbon in San Juan County

Biomass Sources

WISEWOOD ENERGY

CONVERSION FACTORS AND PARAMETERS

1 US TON:	2,000	LBS
RAW MATERIAL MOISTURE CONTENT:	40%	MC
DRY CHIPS MOISTURE CONTENT:	**10%**	MC
GREEN BULK DENSITY:	17.1	LB/FT3
DRY BULK DENSITY:	12	LB/FT3
1 YD^3:	27	FT^3
ENERGY IN WOOD, BONE-DRY:	8,000	BTUS/LB
ENERGY IN WOOD, DRY (10% MC):	7,102.96	BTUS/LB
CHIPS DRYER EFFICIENCY:	3,000	BTUS/LB
1 KW:	3412	BTUS
1 hp:	1.341	kW
125 kW GASIFIER OUTPUT RATING (kW-el):	125	kW
65 kW GASIFIER OUTPUT RATING (kW-el):	65	kW
125 kW GASIFIER OUTPUT RATING (kW-th):	238	kW
65 kW GASIFIER OUTPUT RATING (kW-th):	125	kW
GASIFIER FUEL DEMAND, DRY CHIPS @10%MC - Holtz 125Kw:	**45**	Kg/hr
GASIFIER FUEL DEMAND, DRY CHIPS @10%MC - Holtz 65Kw:	**87**	Kg/hr
FTE HRS/YR:	2080	HRS/YR
MAINTENANCE HRS - WOOD PROCESSING EQUIPMENT:	0.5	HRS PER 8 HR DAY

125 kW GASIFIER SPECS

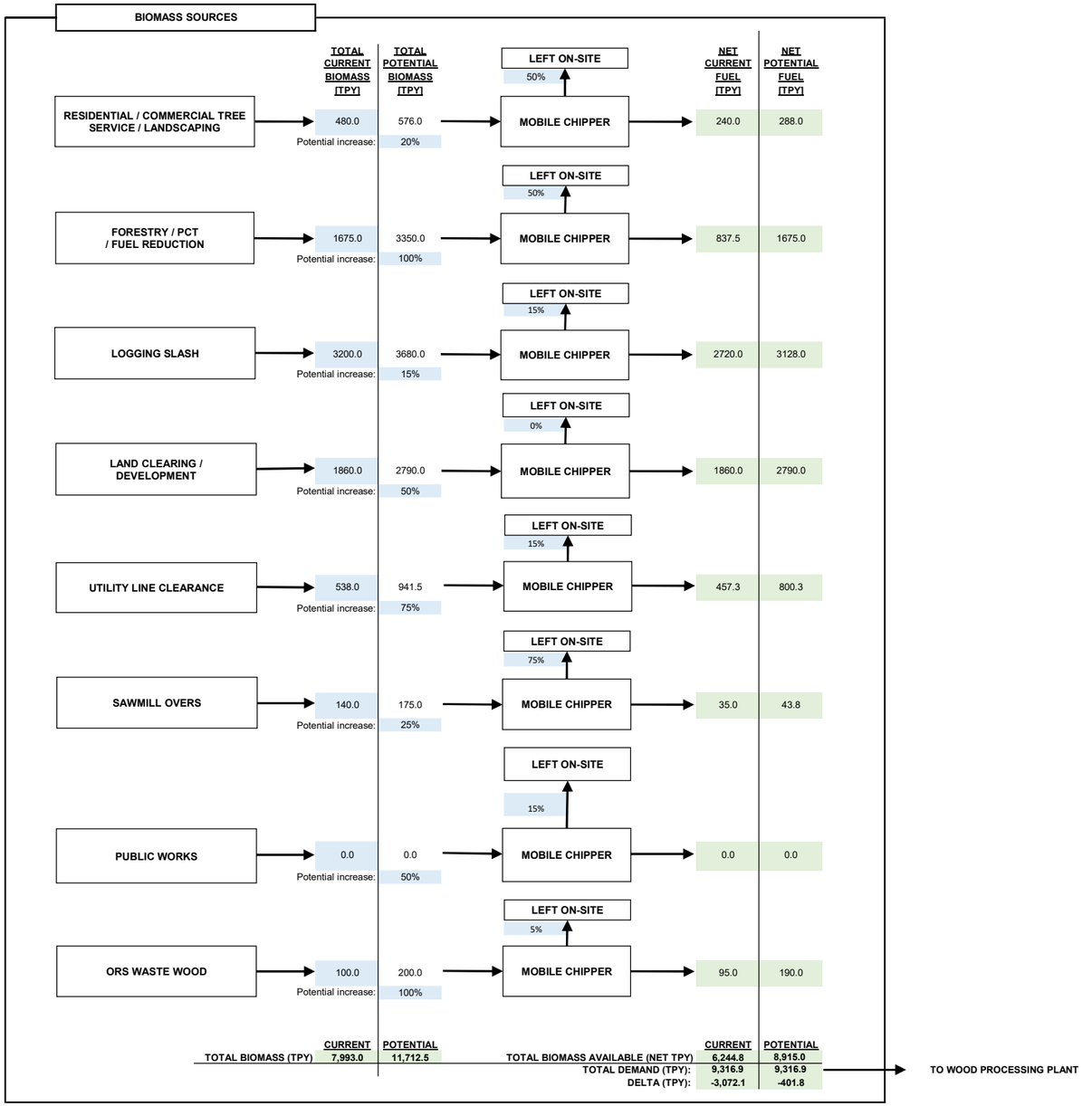
125kW GASIFIER OUTPUTS: **125kW-el, 238kW-th**
125kW GASIFIER FUEL DEMAND: **5430m^3 dry chips / year**

65 kW GASIFIER SPECS

65kW GASIFIER OUTPUTS: **65kW-el , 125kW-th**
65kW GASIFIER FUEL DEMAND: **2900m^3 dry chips / year**

OPERATION SCHEDULE

PLANT	HRS / DAY	DAYS / WEEK	WEEKS / YR	HRS / YR
CHIPS LINE	8	5	48	1920
DRYER	24	5	48	5760
GASIFIERS	24	7	48.81	8200

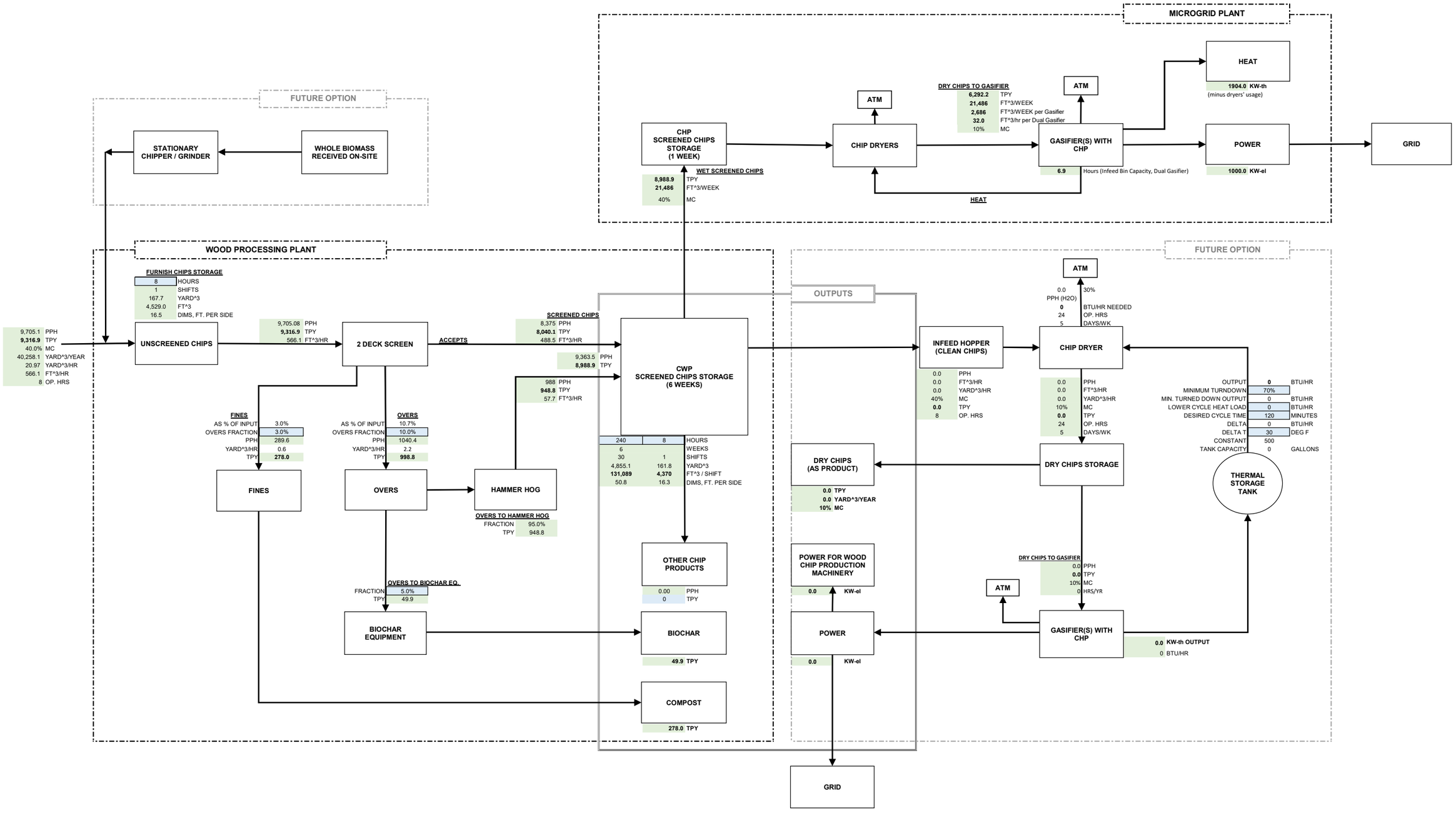


San Juan Island Conservation District

Appropriate Technologies for Fire Mitigation, Energy Independence, & Soil Carbon in San Juan County

Biomass CHP Block Diagram

WISEWOOD ENERGY



Attachment 3

Microgrid CHP Preliminary Energy & Cost Analysis

San Juan Island Conservation District

Appropriate Technologies for Fire Mitigation, Energy Independence, & Soil Carbon in San Juan County

Preliminary Scenario Energy & Cost Analysis

WISEWOOD ENERGY

Location Eastsound, WA
Client Contact Kai Hoffman-Krull
Date Last Modified 8/20/21

Proposed System Power Plant
Proposed System Output (kW) 1,000
Proposed System Fuel Type Wood Chips

Project Manager Meagan Hartman
Email info@wisewoodenergy.com

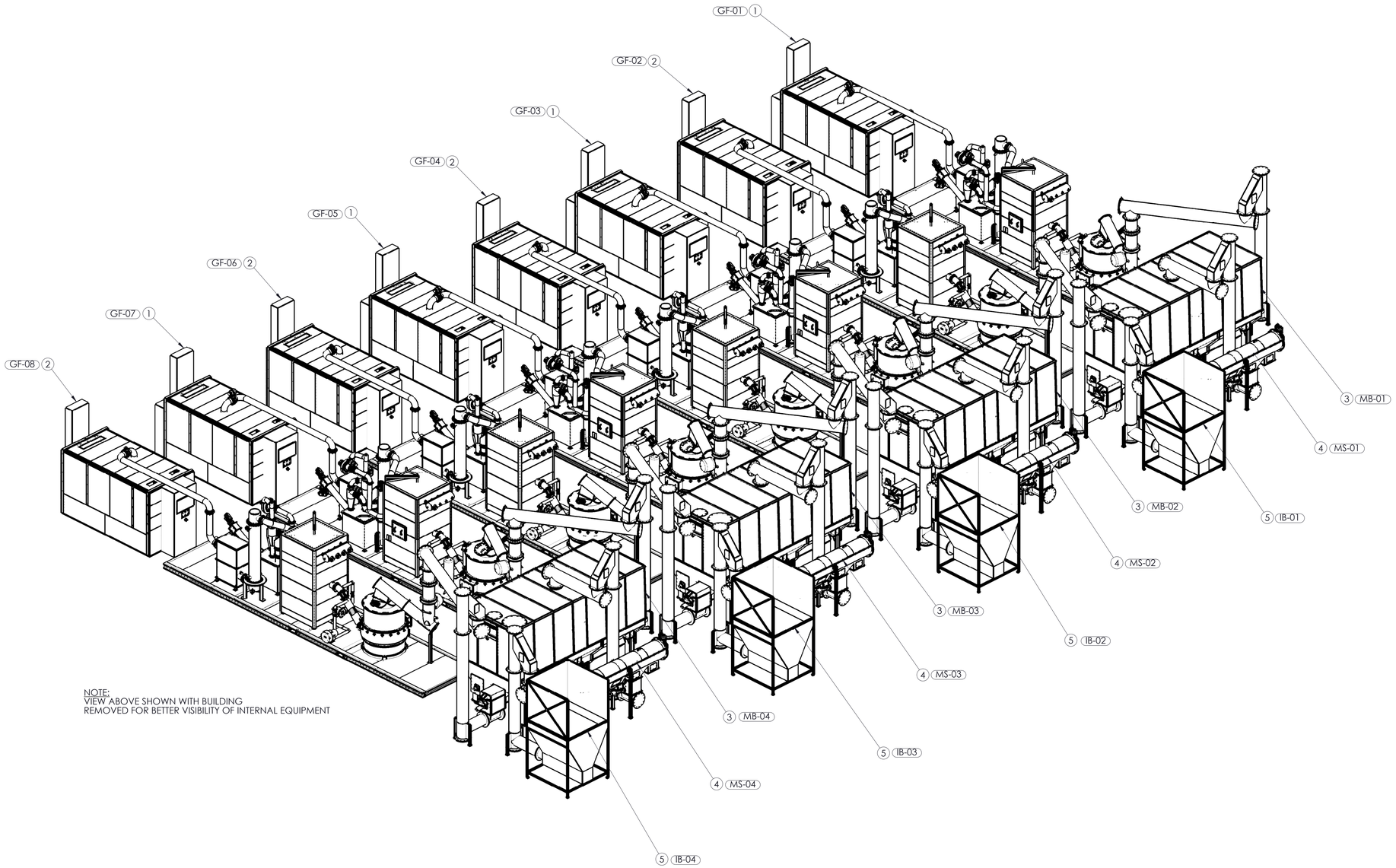
	Critical Facility Check County Buildings *Sourced From: Interval Data* 1000 kW	Holz Gasifier Eastsound Substation *Sourced From: Interval Data* 1000 kW
SCENARIO SUMMARY		
Existing Energy Usage		
Existing electricity usage [kWh/yr]	194,255	37,416,711
Existing thermal energy usage [MMBtu/yr]	-	-
Biomass Gasifier Capacity		
Number of gasifier units	8	8
Nominal electricity capacity [kW]	1,000	1,000
Nominal heat capacity [kW]	1,904	1,904
Modeled plant availability [hrs/yr]	7,500	7,500
Electricity Output		
Annual gross electricity production [kWh/yr]	7,500,000	7,500,000
Annual parasitic demand & downtime [kWh/yr]	300,000	300,000
Estimated net electricity production [kWh/yr]	7,200,000	7,200,000
Estimated percent coverage [%]	3706%	19%
Estimated electricity surplus (shortfall) [kWh/yr]	7,005,745	(30,216,711)
Thermal Energy Output		
Estimated thermal energy production [MMBtu/yr]	48,723	48,723
Wood drying heat demand [MMBtu/yr]	6,211	6,211
Estimated net thermal energy production [MMBtu/yr]	42,512	42,512
Estimated percent coverage [%]	NA	NA
Estimated thermal energy surplus (shortfall) [MMBtu/yr]	42,512	42,512
Wood Fuel Demand		
Type of wood fuel	Wood Chips	Wood Chips
Specified wood fuel moisture content [MC, %]	10%	10%
Wood fuel use [BDT/yr]	5,176	5,176
BIOMASS SYSTEM OPERATING COSTS		
Biomass System Fuel Costs		
Delivered Wood Fuel		
Procured wood fuel moisture content [%]	40%	40%
Wood fuel use @ procured MC [GT/yr]	8,627	8,627
Estimated procured wood fuel price [$/GT]	$55	$55
Subtotal	$474,464	$474,464
Waste Disposal		
Estimated ash generation [ton/yr]	302	302
Ash collection container size [ton]	1.0	1.0
Ash removal [interval/yr]	302	302
Estimated tar generation [lt/yr]	7,500	7,500
Estimated ash disposal fee [$/interval]	$260	$260
Estimated tar disposal fee [$/lt]	$0.51	$0.51
Subtotal	$82,327	$82,327
Biomass System O&M Costs		
Scheduled Internal Maintenance		
Estimated labor rate [$/hr]	$50	$50
Estimated FTE	0.80	0.80
Estimated consumables [$/yr]	$208,000	$208,000
Subtotal	$291,513	$291,513
Third Party Services - Biomass		
Estimated labor rate [$/hr]	$125	$125
Estimated maintenance services [avg hrs/yr]	775	775
Subtotal	$96,844	$96,844
Third Party Services - Battery Energy Storage System (BESS)		
O&M Fixed Fee [$/yr]	$0	$0
Software License Fee [$/yr]	$0	$0
Spare Parts Reserve [$/yr]	$0	$0
Microgrid Controller Software License Fee [$/yr]	$0	$0
Subtotal	$0	$0
Third Party Services - Gasifier Engine		
Supplemental engine services [$/yr]	$0	$0
Subtotal	$0	$0
Administration		
Estimated admin [$/yr]	$20,000	$20,000
Estimated remote monitoring services [$/yr]	$5,000	$5,000
Estimated insurance [$/yr]	-	-
Estimatred property taxes [$/yr]	$0	$0
Subtotal	$25,000	$25,000
Biomass System Maintenance Costs	$ 413,356	$ 413,356
Proposed Biomass Operating Cost, Total	$ 970,147	$970,147
ESTIMATED COST OF ENERGY [1]		
Cost of Energy - Potential CHP Electricity [$/kWh]	$0.049	$0.049
Cost of Energy - Potential CHP Heat [$/MMBtu]	$14.46	$14.46
Cost of Energy - Power Only [$/kWh]	$0.135	$0.135

1: Capital cost not included in estimated cost of energy

Attachment 4

Microgrid CHP Preliminary Conceptual Design

ITEM	QTY	UNITS	DESCRIPTION	EQUIPMENT TAG
1	4	EA	GASIFICATION SYSTEM, LEFT HAND	GF
2	4	EA	GASIFICATION SYSTEM, RIGHT HAND	GF
3	4	EA	METERING BIN	MB
4	4	EA	MATERIAL SCREEN	MS
5	4	EA	INFEED BIN	IB
6	4	EA	HEATED FLOOR	HF
7	4	EA	FUEL PILE , 5,400 CUBIC FEET (1 WEEK SUPPLY)	



NOTE:
VIEW ABOVE SHOWN WITH BUILDING
REMOVED FOR BETTER VISIBILITY OF INTERNAL EQUIPMENT

OWNER

SAN JUAN ISLAND CONSERVATION DISTRICT

530 Guard St, Friday Harbor, WA 98250

PROJECT

MICROGRID CHP BIOMASS PROJECT

DESIGN FIRM

WISEWOOD ENERGY
TEL. 503.608.7366
FAX 503.715.0483
INFO@WISEWOODENERGY.COM
WWW.WISEWOODENERGY.COM
735 N ALBERTA STREET
PORTLAND, OR 97217

DRAWING TITLE

GASIFICATION PROCESS CONCEPTUAL GENERAL ARRANGEMENT

REVISIONS

REFERENCE DRAWINGS

	DWG #	DWG TITLE
1		
2		
3		
4		
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7		
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ENGINEER'S STAMP

DRAWING TYPE

ISSUED FOR INFORMATION
IFI

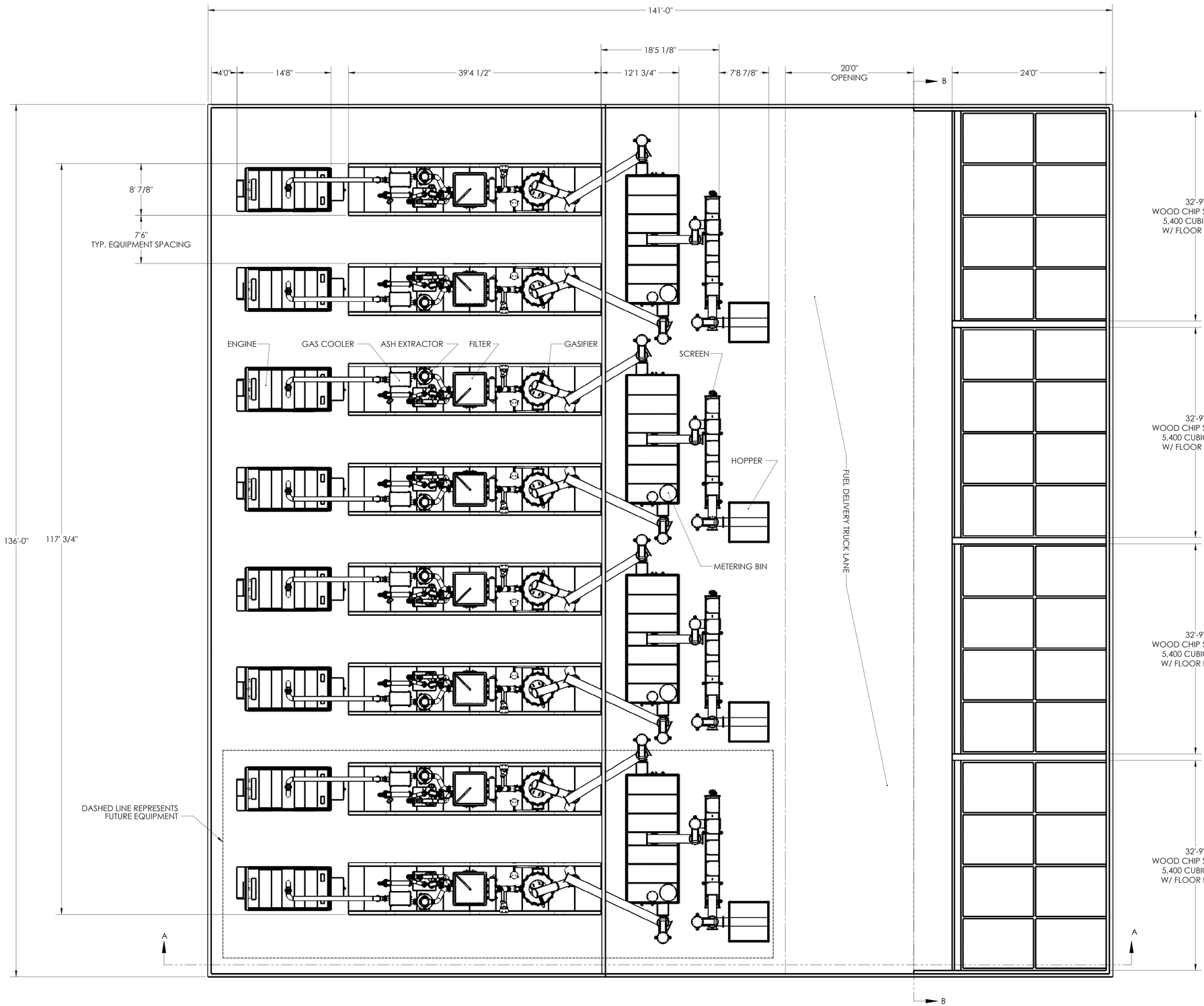
SCALE 1:70

THIS LINE IS 2" AT FULL SCALE
IF IT DOES NOT MEASURE 2"
SCALE ACCORDINGLY

DRAWN: A. WINITZKY	DATE: 2021-03-12
CHECKED:	DATE:
APPROVED:	DATE:
PROJECT: 043.SJI.CHP	

DRAWING NO.

043-100-101.1



OWNER

SAN JUAN ISLAND CONSERVATION DISTRICT

530 Guard St, Friday Harbor, WA 98250

PROJECT

MICROGRID CHP BIOMASS PROJECT

DESIGN FIRM

WISEWOOD ENERGY
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DRAWING TITLE

GASIFICATION PROCESS CONCEPTUAL GENERAL ARRANGEMENT

REVISIONS

REV	DESCRIPTION	DRAWN: DATE:	APROVED: DATE:

REFERENCE DRAWINGS

	DWG #	DWG TITLE
1		
2		
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11		

ENGINEER'S STAMP

DRAWING TYPE

ISSUED FOR INFORMATION
IFI

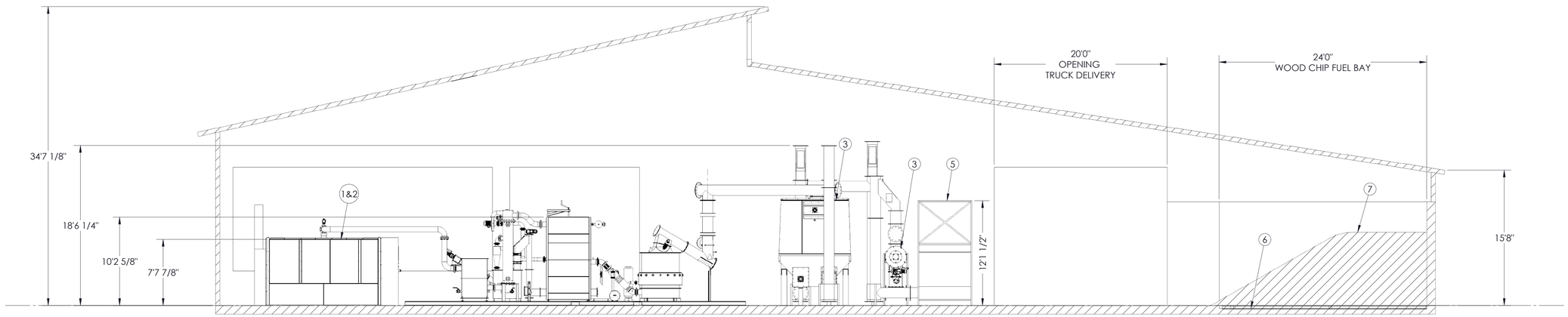
SCALE 1:90

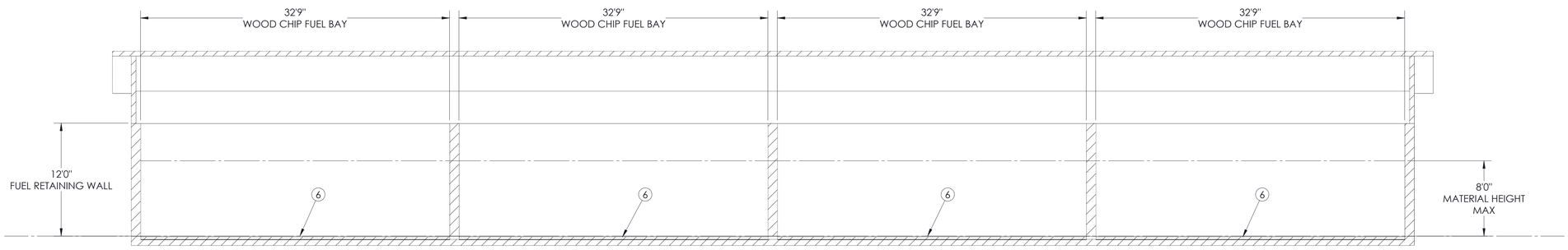
THIS LINE IS 2" AT FULL SCALE
IF IT DOES NOT MEASURE 2"
SCALE ACCORDINGLY

DRAWN: A. WINITZKY	DATE: 2021-03-12
CHECKED:	DATE:
APPROVED:	DATE:
PROJECT: 043.SJI.CHP	

DRAWING NO.

043-100-101.2





VIEW INSIDE BUILDING LOOKING AT FUEL BAYS

OWNER

SAN JUAN ISLAND CONSERVATION DISTRICT

530 Guard St, Friday Harbor, WA 98250

PROJECT

MICROGRID CHP BIOMASS PROJECT

DESIGN FIRM

WISEWOOD ENERGY
TEL. 503.608.7366
FAX 503.715.0483
INFO@WISEWOODENERGY.COM
WWW.WISEWOODENERGY.COM
735 N ALBERTA STREET
PORTLAND, OR 97217

DRAWING TITLE

GASIFICATION PROCESS CONCEPTUAL GENERAL ARRANGEMENT

REVISIONS

REV	DESCRIPTION	DRAWN: DATE:	APROVED: DATE:

REFERENCE DRAWINGS

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ENGINEER'S STAMP

DRAWING TYPE

ISSUED FOR INFORMATION
IFI

SCALE 1:75

THIS LINE IS 2" AT FULL SCALE
IF IT DOES NOT MEASURE 2"
SCALE ACCORDINGLY

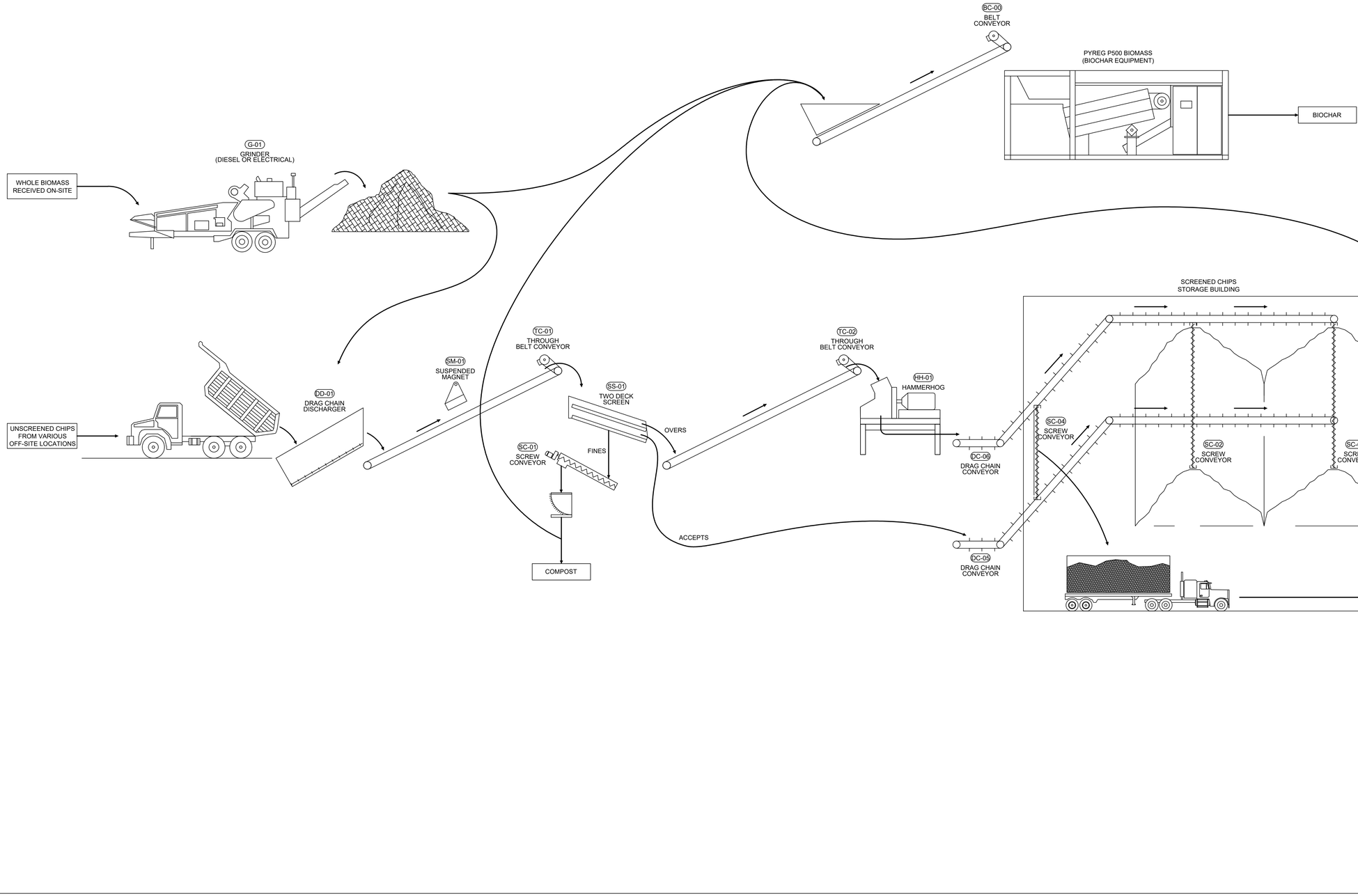
DRAWN: A. WINITZKY	DATE: 2021-03-15
CHECKED:	DATE:
APPROVED:	DATE:
PROJECT: 043.SJI.CHP	

DRAWING NO.

043-100-101.3

Attachment 5

Central Wood Processing Site Conceptual Process Flow Diagram



OWNER

SAN JUAN ISLANDS CONSERVATION DISTRICT

SAN JUAN ISLAND, WASHINGTON

PROJECT

SAN JUAN ISLANDS CHP PROJECT

DESIGN FIRM

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WWW.WISEWOODENERGY.COM
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PORTLAND, OR 97217

DRAWING TITLE

PROCESS FLOW DIAGRAM

REVISIONS

REV	DESCRIPTION	DRAW DATE:	APPROVED DATE:

REFERENCE DRAWINGS

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ENGINEER'S STAMP

DRAWING TYPE

ISSUED FOR REVIEW

IFR

THIS LINE IS 2 INCHES
AT FULL SCALE
IF IT DOES NOT MEASURE 2 INCHES, SCALE ACCORDINGLY

DRAWN: J. RIVAS DATE: 2021-04-06

CHECK:

APPROVED:

PROJECT:

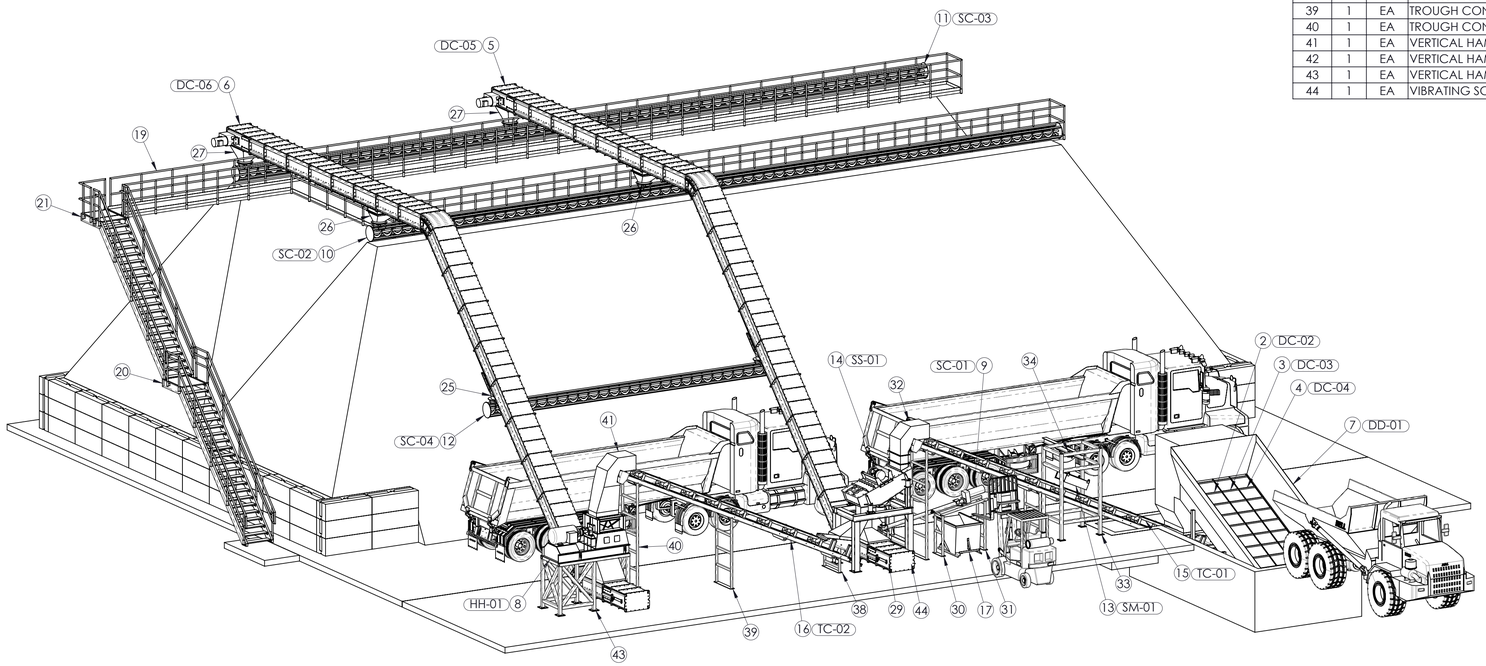
DRAWING NO.

043-110-002

Attachment 6

Central Wood Processing Site Preliminary Conceptual Design

ITEM	QTY	UNITS	DESCRIPTION	EQUIPMENT TAG
1	1	EA	DISCHARGER DRAG CHAIN	DC-01
2	1	EA	DISCHARGER DRAG CHAIN	DC-02
3	1	EA	DISCHARGER DRAG CHAIN	DC-03
4	1	EA	DISCHARGER DRAG CHAIN	DC-04
5	1	EA	DRAG CHAIN CONVEYOR	DC-05
6	1	EA	DRAG CHAIN CONVEYOR	DC-06
7	1	EA	DRAG CHAIN DISCHARGER	DD-01
8	1	EA	VERTICAL HAMMER HOG	HH-01
9	1	EA	FINES DISCHARGE SCREW CONVEYOR	SC-01
10	1	EA	OPEN BODY SCREW CONVEYOR	SC-02
11	1	EA	OPEN BODY SCREW CONVEYOR	SC-03
12	1	EA	OPEN BODY SCREW CONVEYOR	SC-04
13	1	EA	SUSPENDED MAGNET	SM-01
14	1	EA	SHAKER SCREEN	SS-01
15	1	EA	UNSCREENED CHIPS TROUGH CONVEYOR	TC-01
16	1	EA	ACCEPTS TROUGH CONVEYOR	TC-02
17	1	EA	1 YARD SELF DUMPING FORKLIFT HOPPER	
18	1	EA	ACCEPTS CONVEYOR INLET CHUTE	
19	1	EA	CATWALK	
20	1	EA	CATWALK LOWER STAIRS	
21	1	EA	CATWALK UPPER STAIRS	
22	1	EA	DRAG CHAIN DISCHARGER OUTLET CHUTE	
23	132	EA	ECOLOGY BLOCK, 2' X 6' X 2'	
24	1	EA	FINES DISCHARGE SCREW INLET CHUTE	
25	2	EA	FINISHED WOOD CHIPS DRAG CHAIN CONVEYOR OUTLET CHUTE 1	
26	2	EA	FINISHED WOOD CHIPS DRAG CHAIN CONVEYOR OUTLET CHUTE 2	
27	2	EA	FINISHED WOOD CHIPS DRAG CHAIN CONVEYOR OUTLET CHUTE 3	
28	1	EA	OVERS DISCHARGE SCREW INLET CHUTE	
29	1	EA	SCREW CONVEYOR SC-01 SUPPORT 1	
30	1	EA	SCREW CONVEYOR SC-01 SUPPORT 2	
31	1	EA	SCREW CONVEYOR SC-01 SUPPORT 3	
32	1	EA	SHAKER SCREEN INLET CHUTE	
33	1	EA	SUSPENDED MAGNET HOIST BEAM	
34	1	EA	SUSPENDED MAGNET HOIST TROLLEY	
35	1	EA	TROUGH CONVEYOR TC-01 SUPPORT 1	
36	1	EA	TROUGH CONVEYOR TC-01 SUPPORT 2	
37	1	EA	TROUGH CONVEYOR TC-01 SUPPORT 3	
38	1	EA	TROUGH CONVEYOR TC-03 SUPPORT 1	
39	1	EA	TROUGH CONVEYOR TC-03 SUPPORT 2	
40	1	EA	TROUGH CONVEYOR TC-03 SUPPORT 3	
41	1	EA	VERTICAL HAMMER HOG INLET CHUTE	
42	1	EA	VERTICAL HAMMER HOG OUTLET CHUTE	
43	1	EA	VERTICAL HAMMER HOG STAND	
44	1	EA	VIBRATING SCREEN STEEL SUPPORT STRUCTURE	



OWNER

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PORTLAND, OR 97217

DRAWING TITLE

CENTRAL WOOD PROCESSING CONCEPTUAL GENERAL ARRANGEMENT

REVISIONS

REV	DESCRIPTION	DRAWN: DATE:	APROVED: DATE:

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ENGINEER'S STAMP

DRAWING TYPE

ISSUED FOR INFORMATION
IFI

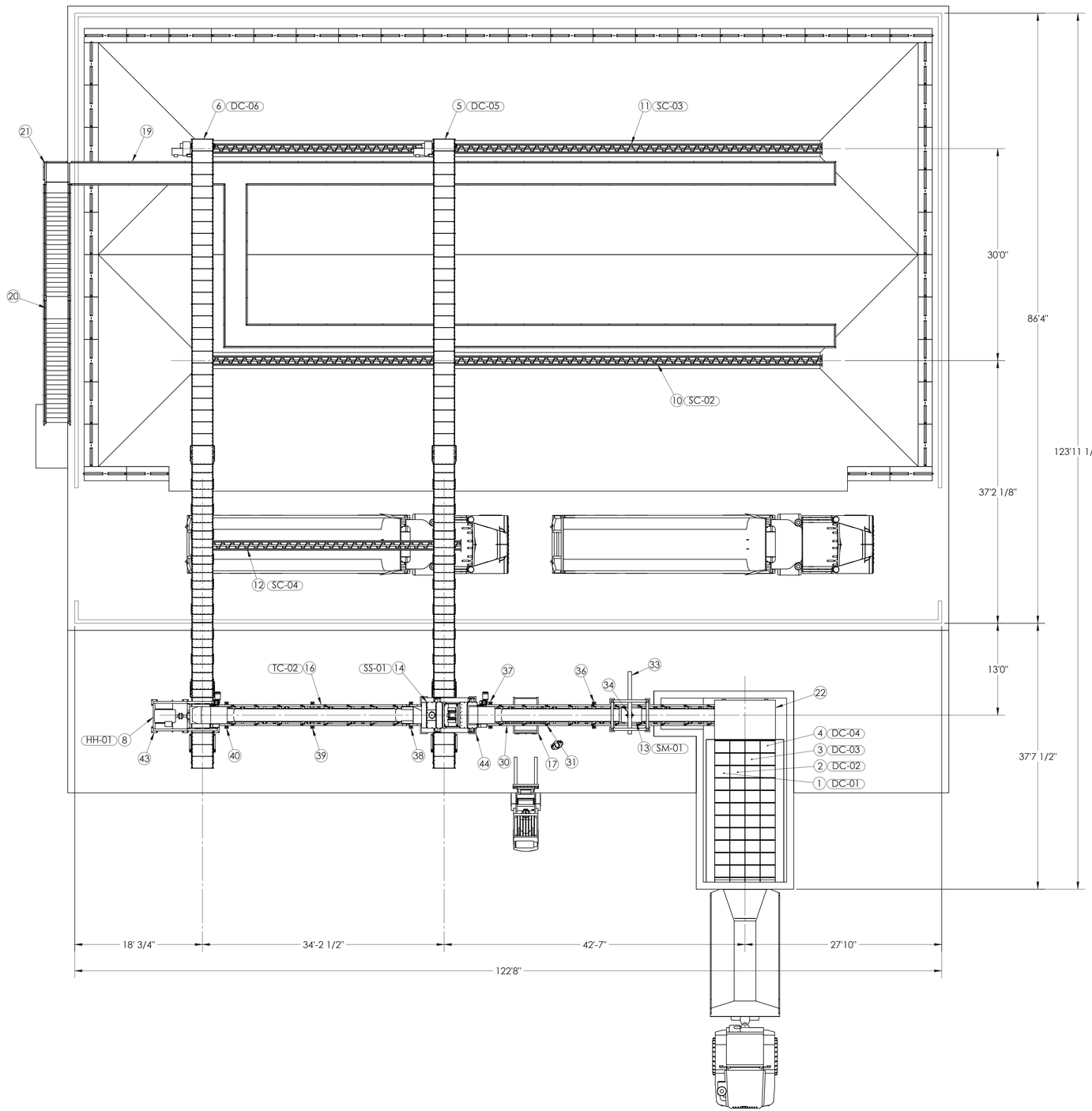
SCALE 1:96

THIS LINE IS 2" AT FULL SCALE
IF IT DOES NOT MEASURE 2"
SCALE ACCORDINGLY

DRAWN: D. RECORD	DATE: 2021-04-01
CHECKED:	DATE:
APPROVED:	DATE:
PROJECT: SJI	

DRAWING NO.

043-101-101.1



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DRAWN: D. RECORD	DATE: 2021-04-01
CHECKED:	DATE:
APPROVED:	DATE:
PROJECT: SJI	

DRAWING NO.

043-101-101.2

Attachment 7

Rough Order Magnitude of Capital Cost

San Juan Island Conservation District

WISEWOOD ENERGY

Appropriate Technologies for Fire Mitigation, Energy Independence, & Soil Carbon in San Juan County

Rough Order Magnitude of Capital Costs

Location Eastsound, WA
Client Contact Kai Hoffman-Krull
Date Last Modified 5/25/21

Proposed System Power Plant
Proposed System Output (kW) 1000
Fuel Type Wood Chips

Project Manager Meagan Hartman
Email info@wisewoodenergy.com

Microgrid Gasifier Substation Option 1 - Automated, Holz	
Gasifier Substation	
Gasifier Model - Holz 125kW, 8 units	
Fuel Conveyance System - Automated	
Drying System - Floor Panels	
Building System - Basic Steel/Concrete Building	
Microgrid	
Total Estimated ROM Costs, Incl. Labor	**$11,100,000**

Microgrid Gasifier Substation Option 2 - Manual, Holz	
Gasifier Substation	
Gasifier Model - Holz 125kW, 8 units	
Fuel Conveyance System - Manual	
Drying System - Floor Panels	
Building System - Basic Steel/Concrete Building	
Microgrid	
Total Estimated ROM Costs, Incl. Labor	**$10,500,000**

Microgrid Gasifier Substation Option 3 - Automated, Syncraft	
Gasifier Substation	
Gasifier Model - Syncraft CW1800, 2 units	
Fuel Conveyance System - Automated (Included)	
Drying System - Floor Panels (Included)	
Building System - Basic Steel/Concrete Building	
Microgrid	
Total Estimated ROM Costs, Incl. Labor	**$13,100,000**

Central Wood Processing	
Central Wood Processing - Major Equipment	
Discharger Drag Chain	
Drag Chain Conveyor (102')	
Drag Chain Conveyor (102')	
Drag Chain Discharger	
Vertical Hammer Hog	
Fines Discharge Screw Conveyor	
Open Body Screw Conveyor (89')	
Open Body Screw Conveyor (89')	
Open Body Screw Conveyor (38')	
Suspended Magnet	
Shaker Screen	
Unscreened Chips Trough Conveyor (45')	
Accepts Trough Conveyor (35')	
Foundation, Ecology Blocks, Building (14,000Ft^2)	
Stairs, Catwalk	
Total Estimated ROM Costs, Incl. Labor	**$ 2,900,000**

NOTE: Rough Order Magnitude costs are based on major equipment as of the last modified date, and are for estimating purposes only.