



BCIT Biomass Education Facility

**Schematic Design and
Cost Plan Study**

March 2012

INTRODUCTION

Background Information

In March of 2012 BCIT Energy Specialists commissioned DA Architects + Planners to undertake a schematic design and costing exercise of a facility that would house a biomass boiler system to process the construction wood waste from the carpentry and joinery workshops on campus.

Location

The facility is to be located near the joinery workshop building in the northeast quadrant of BCIT's Burnaby campus known as building NE2 (fig. 1). An existing Dust Collector, which will collect the wood chips from various parts of the workshop or use as fuel, is located on the west facade. The biomass boiler facility is to be located near this equipment.

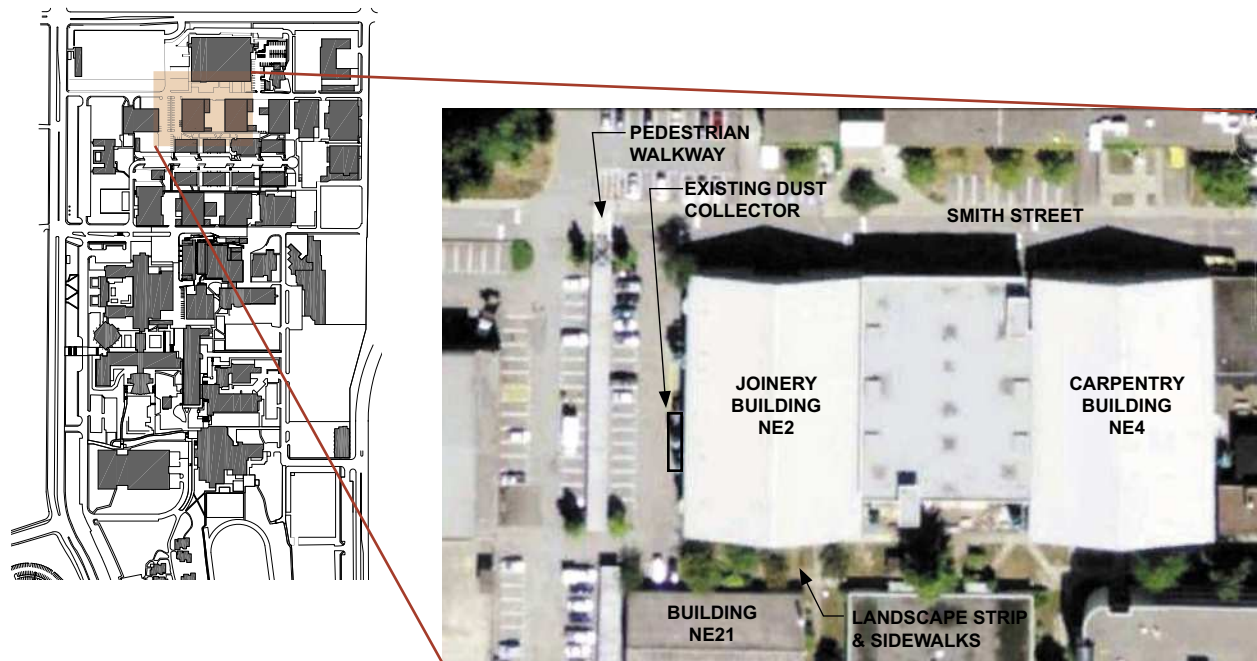


Fig. 1: BCIT Burnaby Campus partial site plan and location plan

Facility Requirements

The biomass boiler system is to comprise of three main elements: a storage area for wood chips, the biomass boilers themselves, and an electrostatic precipitator that serves to filter particulate out of the exhaust air before it is emitted from the system. These components are linked together with various augers and ducts. Additional equipment and requirements are listed in the table below:

<u>Item</u>	<u>Approximate Dimensions*</u>	<u>Notes</u>
Storage Area for wood chips	27 m ³	-
2 x 250kW Biomass Boilers	2.916m L x 1.28m W x 2.33m H each	-
1 x Electrostatic Precipitator	4.1m L x 1.4m W x 3.77m H	-
Boiler Control Panel	0.9m L x 0.3m W x 0.9m H	To be wall-mounted
Precipitator Control Panel	0.7m L x 0.3m W x 0.7m H	To be wall-mounted
Monitoring Unit	0.5m L x 0.4m W x 1.5m H	To be wall-mounted
Exhaust Stack for Precipitator	40ft high	As per City bylaws
Storage for maintenance and cleaning tools	-	Tools to be wall-mounted for display/ educational purposes
Covered Outdoor Viewing Area (with seating)	-	To accommodate approx. 20 students (1 class)

* Note: these dimensions were given as reasonable dimensions for use in schematic design and layout. The dimensions of the actual equipment that will comprise the system might be different and should be confirmed at the design development stage

SCHEMATIC DESIGN OF FACILITY

BUILDING LOCATION

The building is to be located on the landscape strip between Joinery Building NE2 and Building NE21 (Fig. 2).

Advantages of this location include:

- It is a highly visible location from the surrounding pedestrian paths
- Close proximity to the existing dust collector, which results in a shorter travel distance for the wood chips.
- Minimizes required auger spans.
- Does not interfere with traffic flow through the existing parking lot to the west of the joinery building
- Does not block the office windows on the south facade of the joinery building
- Does not disturb the visually strong linear pedestrian pathway on this landscape strip

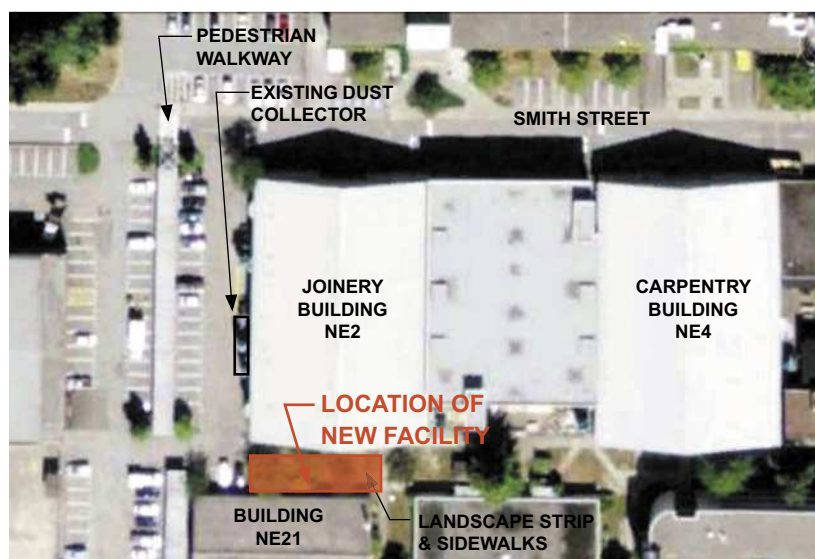


Fig.2: Existing Site Plan, proposed location for Biomass boiler facility

BUILDING DESIGN

Two schematic design options were studied and priced for the purpose of this exercise:

Option 1 - Boiler House with Overhead Storage

An approximately 72m² one-room building with an overhead storage enclosure on the roof (see Fig. 3). The wood chips are transferred from the dust collector to the overhead storage via an auger. The storage area is located directly above the biomass boiler for direct feeding. The boilers are connected in an end-to-end fashion to the precipitator. And exhaust stack exist the building from the precipitator.

Appropriate clearances for access and maintenance are provided inside the space.

There is a covered outdoor viewing area to the west of the boiler house with a wood roof structure, curved bench seating, and glazing looking into the space.

The roof is a flat roof structure designed for a potential green roof installation by BCIT forces.

The cost of this option is \$213,300 (see Cost Estimate)

Option 2 - Subterranean Boiler House with Underground Storage

An approximately 72m² one-room building located one storey underground, with additional underground storage for the wood chips (see Fig. 4). The wood chips are transferred from the dust collector to the underground storage via an auger. The elevation of the storage area is slightly lower than the biomass boilers. A walking floor and mechanical augers transfer the wood chips to the boilers; there is an opportunity here for a viewing grate in the floor to show this part of the process. Again, the boilers are connected in an end-to-end fashion to the precipitator and the exhaust stack exist the building from the precipitator.

Appropriate clearances for access and maintenance are provided inside the space. There is a covered outdoor viewing area at ground level above the boiler house with a wood roof structure, curved bench seating, and glazing looking down into the space. Stairs from the viewing area provide access for to the boiler house.

The roof is a sloping structure designed for a potential green roof installation by BCIT forces. The roof slopes from the top of the covered viewing area down to integrate seamlessly with the existing landscape strip.

The cost of this option is \$265,900 (see Cost Estimate)

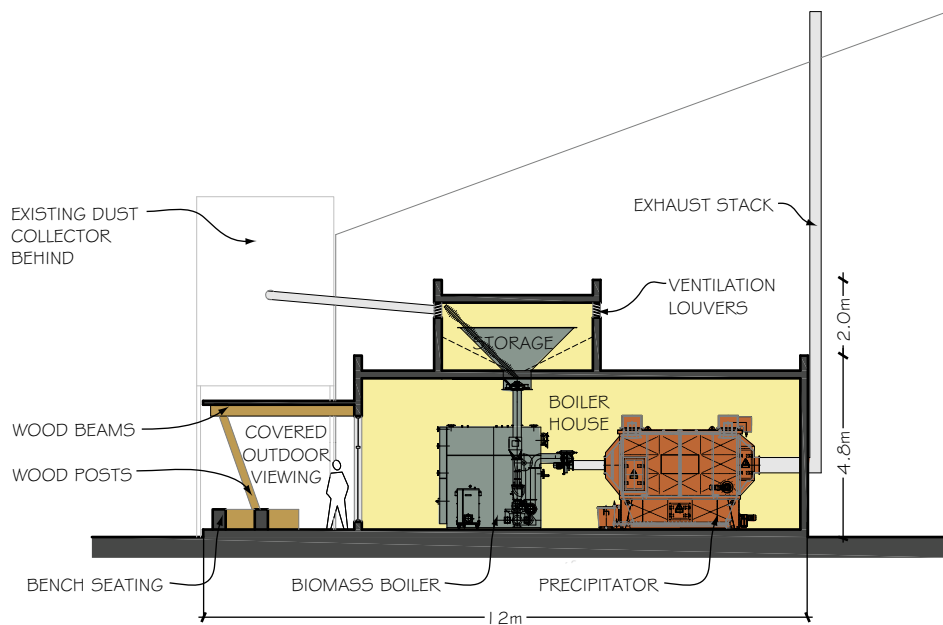
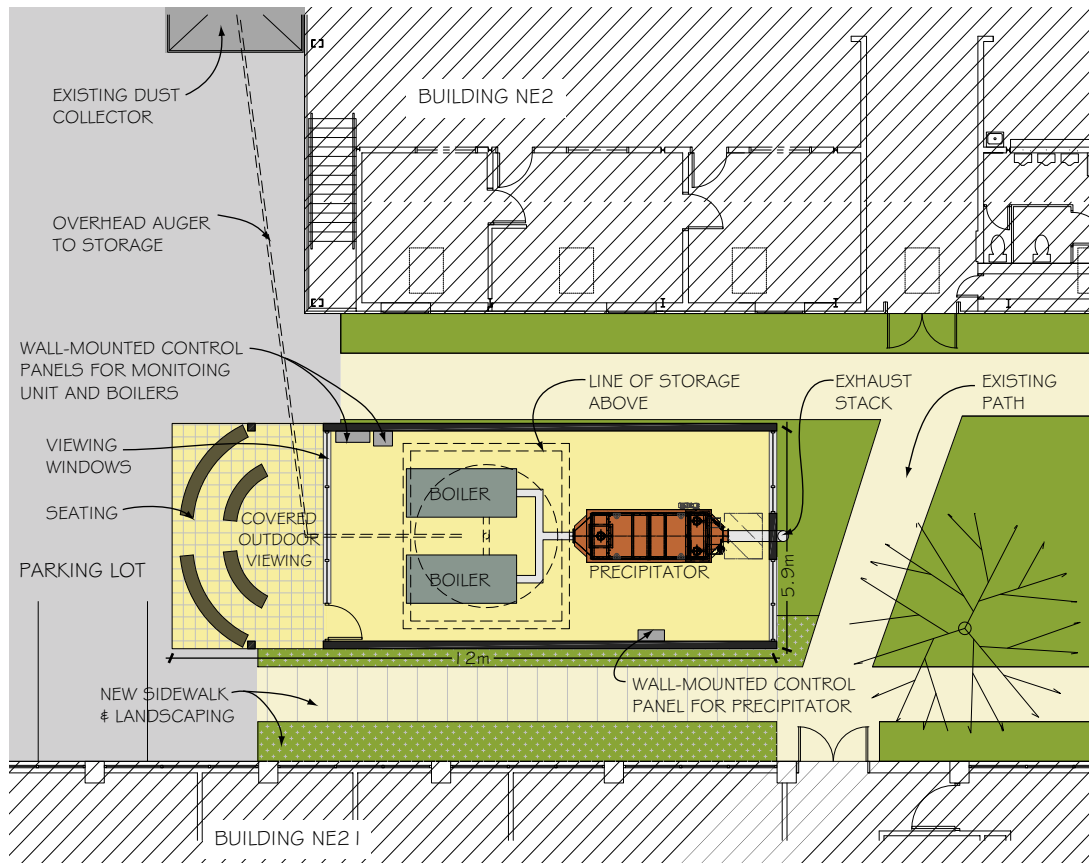


Fig.3: Option 1 Floor Plan and Section

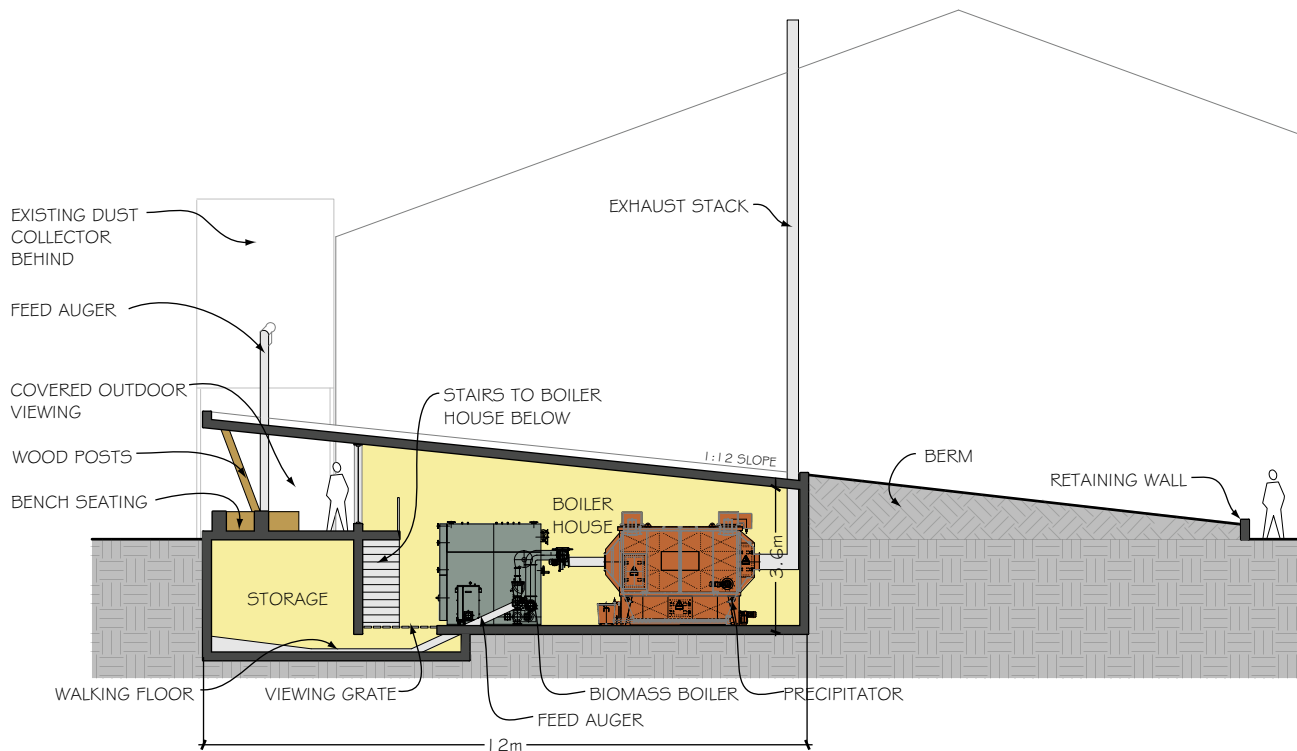
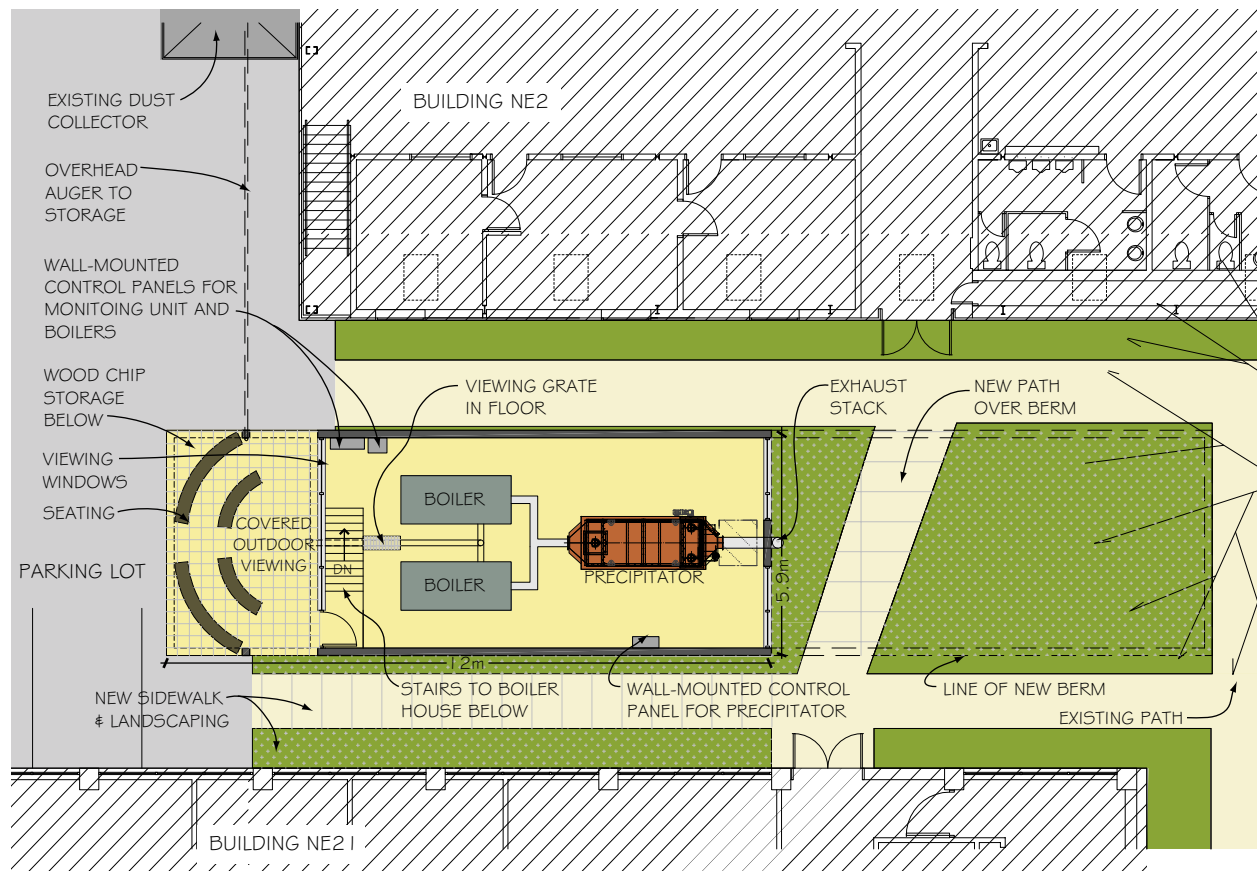


Fig.4: Option 2 Floor Plan and Section

COST ESTIMATE

The following summary is an excerpt from the Cost Plan - see Appendix A for full report.

PROJECT COST SUMMARY – OPTION 1	\$	\$/M2	%
Substructure	6,000	83	3
Structure	27,100	376	13
Exterior Enclosure	86,100	1,196	42
Mechanical	8,100	113	4
Electrical	7,300	101	4
Sitework	16,200	225	8
Ancillary Work	2,500	35	1
General Contractors Overhead & Profit	40,600	564	19
Allowances	19,400	269	9
Total Hard Costs	\$ 213,300	\$ 2,963	100

PROJECT COST SUMMARY – OPTION 2	\$	\$/M2	%
Substructure	6,000	83	3
Structure	45,500	632	18
Exterior Enclosure	79,800	1,108	31
Mechanical	8,100	113	4
Electrical	7,300	101	3
Sitework	41,800	581	16
Ancillary Work	2,500	35	1
General Contractors Overhead & Profit	50,700	704	19
Allowances	24,200	336	9
Total Hard Costs	\$ 265,900	\$ 3,693	100

AREA ANALYSIS

Area 72 M2

ADDITIONAL CONSIDERATIONS

Further study and refinement of the chosen option is required at the next stage. Some additional considerations to be studied further include:

- In both options, at least one parking spot lost
- Both options require the removal/relocation of existing trees: 2 trees for Option 1 and 3 trees for Option 2.
- The above-mentioned costs are for the 'shell' building only. All system components, machines, augers, connections and hook-ups are not included in this estimate. Further study of the exact configuration of this system is required in conjunction with a biomass expert.

APPENDIX A
COST PLAN, CONCEPTUAL DESIGN STAGE



BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC

MARCH 27TH 2012

Cost Plan
Conceptual Design Stage

Submitted To:

Ms. Andrea Chynoweth
DA Architects + Planners

BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC



March 27th 2012

PROJECT COST SUMMARY – OPTION 1	\$	\$/M2	%
Substructure	6,000	83	3
Structure	27,100	376	13
Exterior Enclosure	86,100	1,196	42
Mechanical	8,100	113	4
Electrical	7,300	101	4
Sitework	16,200	225	8
Ancillary Work	2,500	35	1
General Contractors Overhead & Profit	40,600	564	19
Allowances	19,400	269	9
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Total Hard Costs	\$ 213,300	\$ 2,963	100

PROJECT COST SUMMARY – OPTION 2	\$	\$/M2	%
Substructure	6,000	83	3
Structure	45,500	632	18
Exterior Enclosure	79,800	1,108	31
Mechanical	8,100	113	4
Electrical	7,300	101	3
Sitework	41,800	581	16
Ancillary Work	2,500	35	1
General Contractors Overhead & Profit	50,700	704	19
Allowances	24,200	336	9
	-----	-----	-----
Total Hard Costs	\$ 265,900	\$ 3,693	100

AREA ANALYSIS

Area 72 M2

BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC



March 27th 2012

PROJECT DESCRIPTION

This project comprises the construction of a new Biomass Education Facility within the Burnaby Campus of BCIT.

The project has two options to consider:

- Option 1 – Above Grade - slab on grade; concrete block wall superstructure
- Option 2 – Subterranean – slab on grade; cast in place concrete basement walls

Both options have external viewing facilities consisting of a wood framed enclosure with benches sited on paving slabs.

Mechanical systems relate to roof drainage and a general allowance for connections. The balance of the systems will be owner supplied.

Electrical works have not been identified; therefore we have made modest allowances for distribution and lighting. The balance of the systems will be Owner supplied.

Sitework comprises of concrete sidewalks and shrub beds. The subterranean option has a landscaping berm and a small retaining wall.

DOCUMENTS AND DATA

This cost plan has been prepared using the following:

- Architectural drawings Option 1 Floor Plan, Option 1 Building Section, Option 2 Building Section all dated 16th March 2012 and Option 2 Floor Plan dated 20th March 2012, all prepared by DA Architects + Planners.

PROJECT CALENDAR

The costs are based on construction commencing in Spring 2012. We estimate a project of this scope will take approximately 4 weeks to complete for Option 1 and 6 weeks to complete for Option 2.

BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC



March 27th 2012

CONTRACT CONDITIONS

The costs are based on the work being executed through a fixed lump sum contract using standard form documents, with bids received, through select tendering, from at least three reputable general contractors.

EXCLUSIONS

Mechanical or Electrical systems
HST
Remediation of existing hazardous materials
Soft costs
Permitting Costs
Financing Costs

DESIGN CONTINGENCY

A design contingency of 10% has been included. During the design process we are required to make a number of assumptions and this contingency is intended to offset the differences between our assumptions regarding these unknowns versus those of the design team. It is not to be considered a fund for additional scope, or an item that can be deleted for cost savings.

INFLATION AND MARKET CONDITIONS

No allowance is included for construction industry inflation, as there has been a slowing of the industry, which is leading to increased competition. This is aided by a reduction in various commodity pricing that is reflected in tender results.

We anticipate this project has the potential to receive satisfactory bids if tendered within the next few months.

BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC



March 27th 2012

CHANGE ORDER CONTINGENCY

We have not included for any unforeseen costs that may arise during construction. A figure of 5% of the construction cost should be allowed for by the Client in their overall Project Budget. This figure should be held separately, controlled and managed by the Client.

METHODOLOGY

The costs were developed through measurement of materials, labour, equipment and items of work in as much detail as the documents would provide. Allowances are included where measurement was not practical. All measurement was carried out in accordance with the Standard Method of Measurement published by the Canadian Institute of Quantity Surveyors.

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 1)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

SUBSTRUCTURE				6,000	83	3
Standard Foundations				6,000	83	
Footings; formwork, rebar, concrete, finish	72	m ²	83.42	6,000		
STRUCTURE				27,100	376	13
Lowest Floor Construction				8,200	114	
Reinforced Concrete Slab on Grade	72	m ²	114.32	8,200		
Roof Construction - Steel				18,900	263	
Allowance; 45kg/sqm for structural steel	3,240	kg	5.00	16,200		
Metal decking	72	m ²	37.67	2,700		
EXTERIOR ENCLOSURE				86,100	1,196	40
Walls Above Grade				24,500	340	
Concrete Block; painted both sides	132	m ²	178.69	23,600		
Louvers	72	m ²	12.00	900		
Windows & Entrances				15,800	219	
Glazing; Aluminum Framed Windows	27	m ²	538.21	14,500		
New PS Frame; Wood Doors; c/w hardware	1	No	1,250.00	1,300		
Roofing				6,600	92	
2 Ply SBS	72	m ²	91.50	6,600		
Projections				31,400	436	
<i>Storage; Over Roof</i>						
Allowance; concrete block exterior wall	45	m ²	178.69	8,000		
Allowance; structural steel roof structure	970	kg	5.00	4,900		
Metal decking	22	m ²	37.67	800		
Roof finish; 2 Ply SBS	22	m ²	91.50	2,000		
<i>Outdoor Viewing</i>						
Allowance; glulam posts and structure	24	m ²	567.60	13,500		
Roof finish; 2 Ply SBS	24	m ²	91.50	2,200		

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 1)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

MECHANICAL				8,100	113	4
Plumbing & Drainage				800	11	
Rainwater collection	96	m ²	8.07	800		
Fire Protection				5,100	71	
Sprinkler system; connections, etc	1	Sum	2,500.00	2,500		
Sprinkler system; heads & piping	96	m ²	26.91	2,600		
HVAC				2,000	28	
Allowance for hook-ups to Owner systems	1	Sum	2,000.00	2,000		
Builder's Work				200	3	
Cutting, patching, coring etc. for mechanical	1	Sum	200.00	200		
ELECTRICAL				7,300	101	3
Distribution				3,100	43	
Standard	72	m ²	43.06	3,100		
Lighting, Devices & Heating				4,100	57	
All areas	96	m ²	43.06	4,100		
Builder's Work				100	1	
Cutting, patching, coring etc. for electrical	1	sum	100.00	100		

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 1)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

SITWORK					16,200	225	8
Preparation					1,500	21	
Site Clearing/Grubbing	1	Sum	1,500.00	1,500			
Hard Surfaces					3,700	51	
Pavers	24	m ²	75.35	1,800			
Concrete Sidewalk	21	m ²	91.50	1,900			
Landscaping					6,000	83	
Shrub Beds	24	m ²	78.48	1,900			
Benches; curved	10	m	410.10	4,100			
Mechanical Site Services					2,500	35	
Systems Connections	1	Sum	2,500.00	2,500			
Electrical Site Services					2,500	35	
Systems Connections	1	Sum	2,500.00	2,500			
ANCILLARY WORK					2,500	35	1
Alterations					2,500	35	
Allowance for cutting and patching to area	1	Sum	2,500.00	2,500			
GENERAL CONTRACTORS OVERHEAD & PROFIT					40,600	564	19
Contractors Overhead	15.0%			23,000			
Contractors Profit	10.0%			17,600			
ALLOWANCES					19,400	269	9
Design Contingency (Misc Items)	10.0%			19,400			
CONSTRUCTION TOTAL (Excluding HST)					213,300	2,963	100

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 2)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

SUBSTRUCTURE				6,000	83	2
Standard Foundations				6,000	83	
Footings; formwork, rebar, concrete, finish	72	m ²	83.42	6,000		
STRUCTURE				45,500	632	17
Lowest Floor Construction				8,500	118	
Reinforced Concrete Slab on Grade	73	m ²	114.32	8,300		
Floor grille	1	m ²	200.00	200		
Upper Floor Construction				5,600	78	
Reinforced Concrete Suspended Slab	24	m ²	236.71	5,600		
Stair Construction				3,500	49	
Metal stairway; including handrails	1	Sum	3,500.00	3,500		
Roof Construction - Steel				27,900	388	
Allowance; 70kg/sqm for structural steel to accommodate green roof finish	5,040	kg	5.00	25,200		
Metal decking	72	m ²	37.67	2,700		

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 2)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

EXTERIOR ENCLOSURE				79,800	1,108	30
Walls Below Grade				43,200	600	
Cast In Place Concrete; 8" thick	136	m ²	316.15	43,200		
Walls Above Grade				8,000	111	
Cast In Place Concrete; 8" thick	25	m ²	316.15	8,000		
Windows & Entrances				6,300	88	
Glazing; Aluminum Framed Windows	9	m ²	538.21	5,000		
New PS Frame; Wood Doors; c/w hardware	1	No	1,250.00	1,300		
Roofing				6,600	92	
2 Ply SBS	72	m ²	91.50	6,600		
Projections				15,700	218	
<i>Outdoor Viewing</i>						
Allowance; glulam posts and structure	24	m ²	567.60	13,500		
Roof finish; 2 Ply SBS	24	m ²	91.50	2,200		
MECHANICAL				8,100	113	3
Plumbing & Drainage				800	11	
Rainwater collection	96	m ²	8.07	800		
Fire Protection				5,100	71	
Sprinkler system; connections, etc	1	Sum	2,500.00	2,500		
Sprinkler system; heads & piping	96	m ²	26.91	2,600		
HVAC				2,000	28	
Allowance for hook-ups to Owner systems	1	Sum	2,000.00	2,000		
Builder's Work				200	3	
Cutting, patching, coring etc. for mechanical	1	Sum	200.00	200		

BIOMASS EDUCATION FACILITY



BCIT, BURNABY, BC (OPTION 2)

27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ /m² %

ELECTRICAL				7,300	101	3
Distribution				3,100	43	
Standard	72	m ²	43.06	3,100		
Lighting, Devices & Heating				4,100	57	
All areas	96	m ²	43.06	4,100		
Builder's Work				100	1	
Cutting, patching, coring etc. for electrical	1	sum	100.00	100		
SITEWORK				41,800	581	16
Preparation				19,000	264	
Site Clearing/Grubbing	1	Sum	1,500.00	1,500		
Bulk excavation; removal; backfill	1	Sum	17,500.00	17,500		
Hard Surfaces				4,400	61	
Pavers; no subbase required	24	m ²	49.52	1,200		
Concrete Sidewalk/Ramps	35	m ²	91.50	3,200		
Landscaping				13,400	186	
Form berm; use excavated material	1	Sum	1,296.00	1,300		
Retaining Wall	5	m ²	316.15	1,700		
Shrub Beds	81	m ²	78.48	6,300		
Benches; curved	10	m	410.10	4,100		
Mechanical Site Services				2,500	35	
Systems Connections	1	Sum	2,500.00	2,500		
Electrical Site Services				2,500	35	
Systems Connections	1	Sum	2,500.00	2,500		

BIOMASS EDUCATION FACILITY

BCIT, BURNABY, BC (OPTION 2)



27th March 2012

ELEMENTAL COST ANALYSIS

Gross Floor Area: 72 m²
\$ \$/m² %

ANCILLARY WORK	2,500	35	1
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Alterations	2,500	35	
Allowance for cutting and patching to area	1 Sum 2,500.00	2,500	

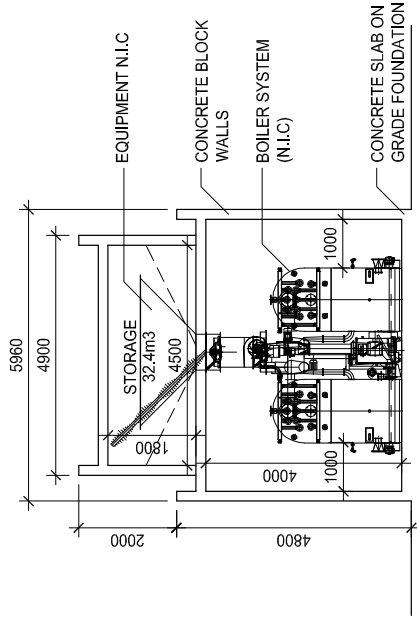
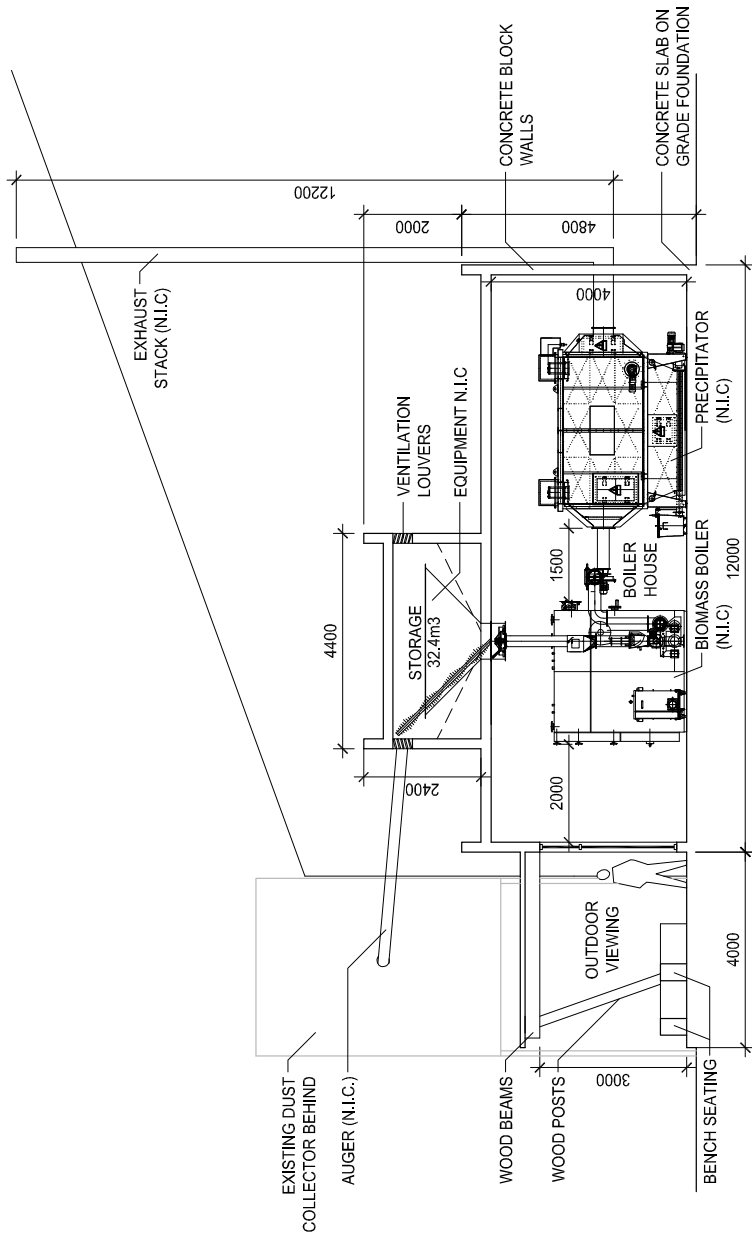
GENERAL CONTRACTORS OVERHEAD & PROFIT	50,700	704	19
Contractors Overhead	15.0%	28,700	
Contractors Profit	10.0%	22,000	

ALLOWANCES	24,200	336	9
Design Contingency (Misc Items)	10.0%	24,200	

CONSTRUCTION TOTAL (Excluding HST)	265,900	3,693	100
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APPENDIX B
SCHEMATIC DESIGN DRAWINGS

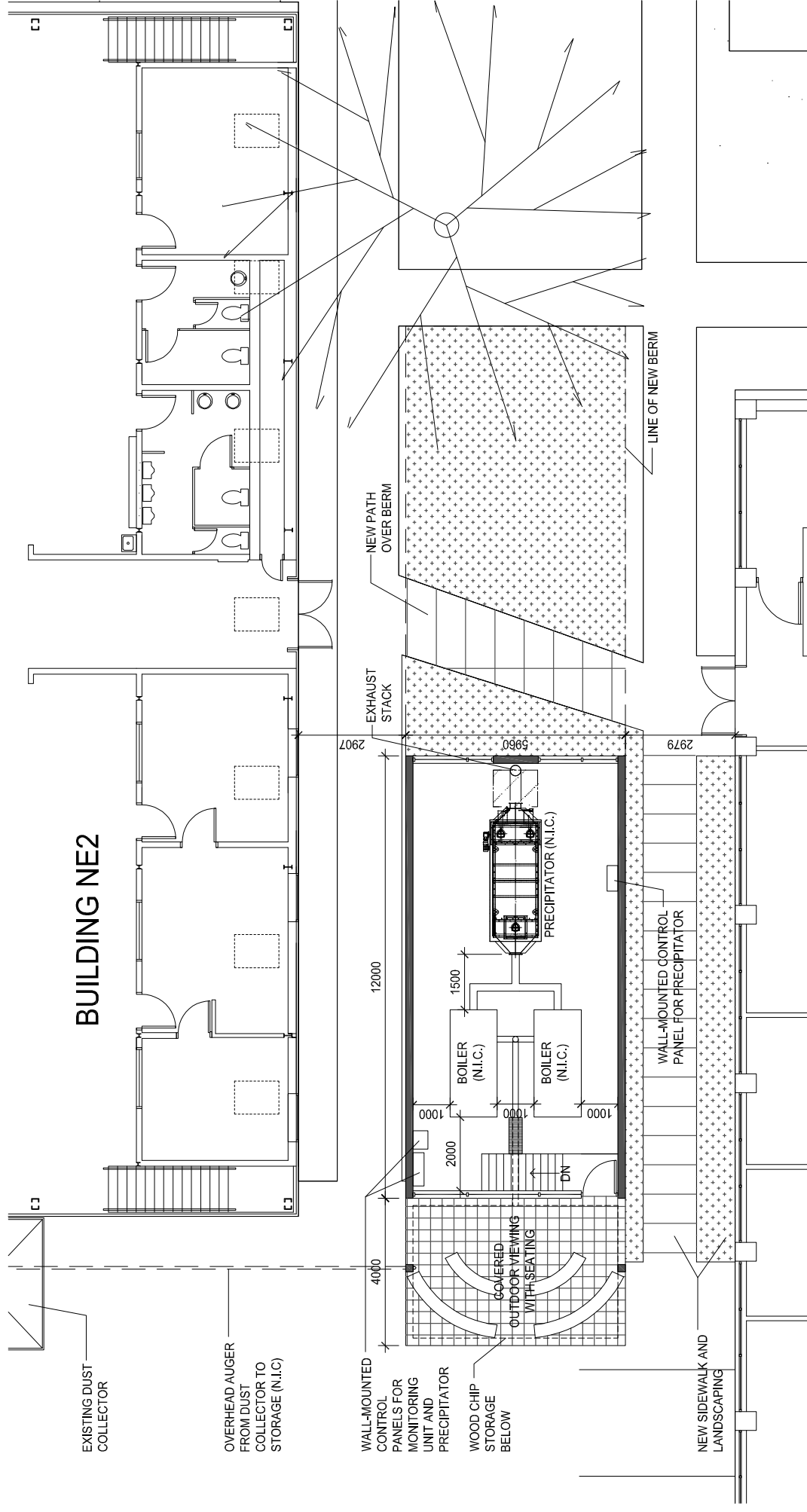




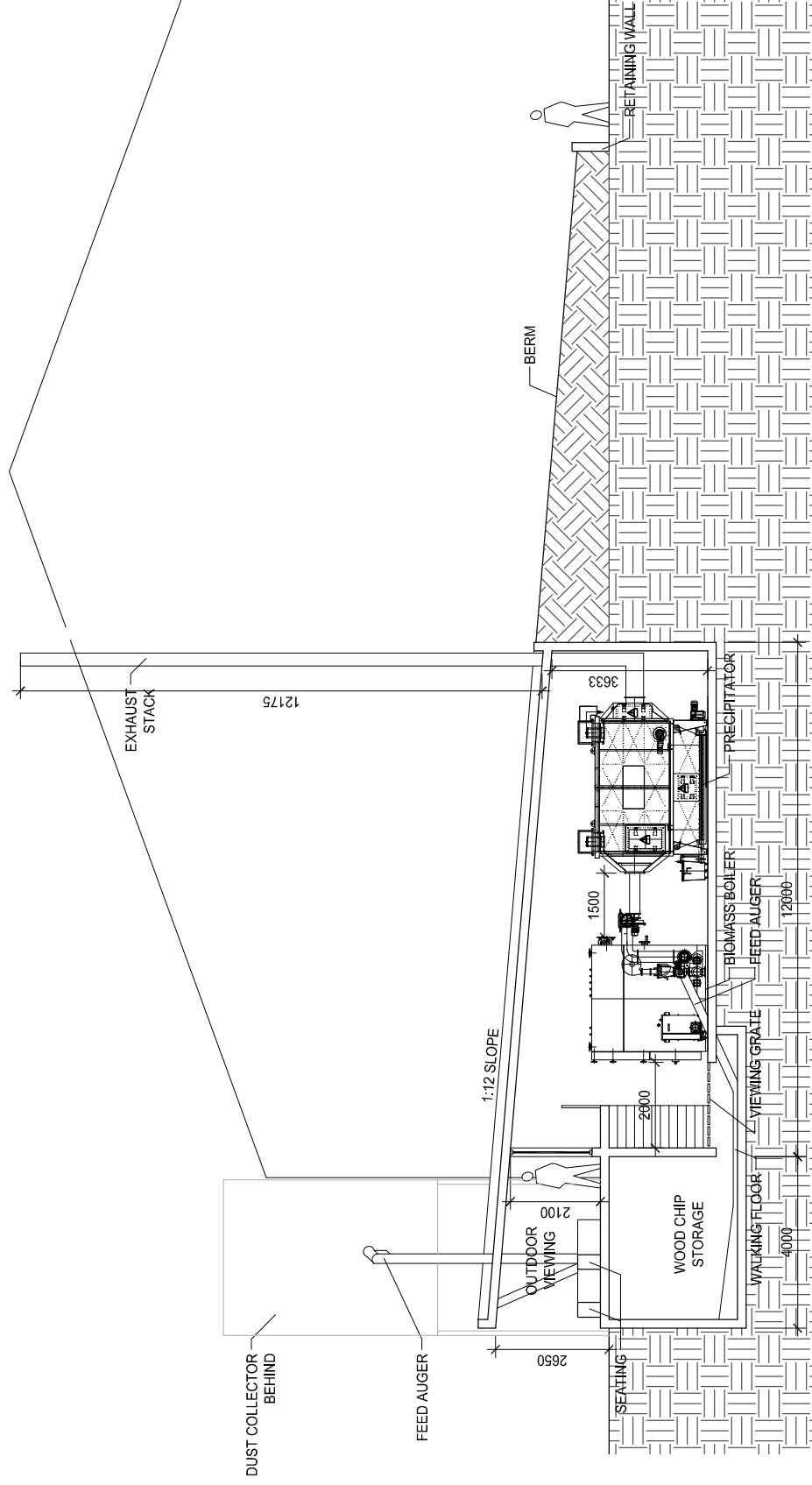
OPTION 1: BUILDING SECTION

BCIT BIOMASS EDUCATION FACILITY

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OPTION 2: FLOOR PLAN
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OPTION 2: BUILDING SECTION
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