



**Verified Carbon
Standard**

BIGCOAST FOREST CLIMATE INITIATIVE



GreenRaise

Document Prepared by GreenRaise Consulting GmbH

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Mosaic Forest Management Corporation (Mosaic) is developing a forest, carbon credit project to create greenhouse gas (GHG) emission reductions and removals by converting privately owned operational forest lands to protected forest lands. The project will be implemented following the Verified Carbon Standard (VCS) VM0012 – Improved Forest Management (IFM) in Temperate and Boreal Forests (LtPF), v1.2 methodology. Mosaic is the timberlands manager for TimberWest Forest Corporation (TimberWest) and Island Timberlands Limited Partnership (Island Timberlands), managing forest planning, operations, and product sales. The project area encompasses properties owned by TimberWest and Island Timberlands, and Mosaic has the authority to implement a carbon crediting project by directing forest planning within the current project activity instance (PAI). The project currently consists of a single activity instance.

The geographic area of the project is located in coastal British Columbia, Canada. The geographic area encompasses the West Coast and South Coast Natural Resource Regions (as defined by the Government of British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development) consisting of an area of approximately 200,000 km². The current PAI (defined as the BigCoast Forest Climate Initiative) are within 44,022 ha of TimberWest and Island Timberlands private forest lands located within Managed Forests 7, 8, 19, 21, 65, 68, 74, and 76 (as established under the Private Managed Forest Land Act of British Columbia). This forest carbon project area is non-contiguous, with parcels located throughout Vancouver Island, Cortes Island, and Haida Gwaii. Old forests (aged >120 years), ecologically significant areas, and culturally important areas were targeted for the forest carbon project.

The BigCoast Forest Climate Initiative (BigCoast) intends to implement a Grouped Project. The project area described in this document incorporates specific areas described for initial project activities being implemented throughout the Mosaic managed land base. Additional project activity instances may be implemented within a similar geographical area, allowing for the use of the initial project baseline scenario for additionality assessments.

Prior to project implementation, the PAI was managed for timber harvesting. Mosaic's land management practices account for non-timber values, including carbon emissions as Mosaic recognizes the importance of science-based approaches to improve company carbon performance.

The project scenario converts harvestable, managed forests to conserved forests by stopping timber harvest within the PAI. Over 15,000,000 tonnes of carbon dioxide equivalent (tCO₂e) are anticipated to be reduced from the atmosphere over the 30-year project period (average of ~500,000 annually).

1.2 Sectoral Scope and Project Type

Sectoral Scope 14

Improved Forest Management (IFM)

Logged to Protected Forest (LtPF)

BigCoast is a Grouped Project, allowing for the addition of PAIs following project validation.

1.3 Project Eligibility

BigCoast (and specifically the current PAI) satisfies the criteria for the VCS Improved Forest Management – Logged to Protected Forests (IFM-LtPF), as defined in the VCS Standard v4.3 and the applicability conditions as described within the VCS-VM0012 v1.2:

1. The project (and specifically the current PAI) meets the most recent approved criteria for VCS IMF-LtPF eligible projects.
2. The project (and specifically the current PAI) is within the Temperate Global Ecological Zone (as defined by Food and Agriculture Organization of the United Nations (FAO) (FAO, 2001), are forest lands (as defined by the Intergovernmental Panel on Climate Change (IPCC)), and which meet IPCC Good Practice Guidance for Land Use, Land-Use Change, and Forestry (GPG-LULUCF) Tier III inventory and data requirements (IPCC, 2003).
3. The project (and specifically the current PAI) meets the most current approved VCS Standard requirements for ownership, by being able to demonstrate Proof of Right of Use ownership of carbon rights in accordance with VCS requirements:
 - a. Mosaic Forest Management, representing TimberWest and Island Timberlands: fee simple ownership of the land, title rights and carbon rights.
4. There are *de minimus* (less than 5%) amounts of illegal, unplanned or fuelwood removals from the PAI in the baseline scenario.
5. The project (and specifically the current PAI) area does not encompass peatland forests as defined by IPCC GPG LULUCF.
6. The total percentage of wetlands within the project area (and specifically the current PAI) is not expected to change as part of the project activities.
7. There is no planned compensatory harvesting on other lands held by owners of the PAI. Activity shifting leakage will be monitored and reported annually as required by VCS standards.
8. The owner of the PAI will not apply organic or inorganic fertilizer in the project scenario.

Future (new) PAI(s) will only be included in the project when the above (and those noted in section 1.4.1) noted eligibility criteria are also met.

1.4 Project Design

BigCoast is a grouped project to allow multiple PAIs to be established within the project area (See Section 1.12). Conditions within the project area at the time of validation have been used to create the baseline scenario and determine project additionality. The baseline scenario and additionality assessments have been completed within one clearly defined geographic area for BigCoast (Figure 1). The current project will only include one project activity, implemented under the VM0012 methodology, and initially one PAI. The baseline scenario has been determined for one geographic area, and this same baseline scenario and geographic area will be used for additional PAIs which may be implemented following initial project validation.

A specific capacity limit does not exist for BigCoast due to the assumption that additional project proponents could be included in the future. However individual capacity limits for each project proponent do exist. The current capacity limit of the sole project proponent (i.e., Mosaic) is set by the harvest capacity limits of the lands currently owned by TimberWest and Island Timberlands. Any PAI added in the future by Mosaic, will not exceed this capacity limit.

1.4.1 Eligibility Criteria for the Inclusion of New Project Activity Instances

Inclusion of additional PAI(s) to BigCoast must adhere to the following eligibility criteria:

1. The PAI must meet the applicability conditions defined in the most recent version of the VCS methodology VM0012 – Improved Forest Management in Temperate and Boreal Forests (LtPF), or conditions specified in the applicable methodology selected.
2. The new PAI must utilize all technologies or measures used in this document and must satisfy conditions of the selected methodology. Any novel technologies utilized shall be clearly identified and defined.
3. Technologies or measures shall be applied in a similar fashion as outlined in this project description document.
4. The PAI will utilize the same baseline scenario as described in Section 3.4 or a baseline scenario appropriate to the specified methodology for the geographic area defined in Section 1.12.
5. The PAI(s) will have characteristics with respect to additionality that are consistent with the initial instance of the project and geographic area. Such characteristics include financial and technical parameters or barriers.
6. Additional activity instance(s) must also satisfy inclusion requirements as outlined in the VCS Standard V4.3, Section 3.5 (Project Design).
7. The PAI must use the GHG information systems and controls (or equivalent) in use by the Project Proponent, Project Developer and/or the Implementation Partner.

For clarity, the current PAI meets the eligibility criteria noted above.

1.4.2 GHG Information Systems and Controls

GHG Information systems include but may not be limited to the following:

1. Carbon Budget Model of the Canadian Forest Service (CBM-CFS3)
2. Woodstock Strategic Planning Optimization from Remsoft (or equivalent)
3. Harvested Wood Products model from Zimmfor Management Services Ltd.
4. Emission model from Zimmfor Management Services Ltd.

5. Uncertainty model from Zimmfor Management Services Ltd.

GHG controls include but may not be limited to the following:

1. Standard Operating Procedure – Monitoring; from GreenRaise Consulting GmbH
2. Standard Operating Procedure – Stakeholder Consultation + Engagement; from GreenRaise Consulting GmbH

1.5 Project Proponent

Table 1 Project Proponent information

Organization name	Mosaic Forest Management Corporation
Role in Project	Project Proponent, Listing Representative
Contact person	David Belezny, P.Eng, RPF
Title	Manager - Hydrology & Terrain
Address	648 Terminal Ave #210, Nanaimo, BC V9R 5E2
Telephone	n/a
Email	david.belezny@mosaicforests.com

1.6 Other Entities Involved in the Project

Table 2. Other entity information

Organization name	GreenRaise Consulting GmbH
Role in the project	Authorized Representative, Implementation Partner, Project Developer
Contact person	Jason Zimmermann, RPF
Title	Director
Address	1010 Vienna, Rudolfsplatz 9/8, Austria
Telephone	+1 604 619 1585
Email	jason@green-raise.com

Organization Name	Zimmfor Management Services Ltd.
Role in the project	Project Developer
Contact person	Jason Zimmermann, RPF
Title	President

Address	2218-D Airport Drive, Campbell River, BC, V9H 0E2, Canada
Telephone	+1 604 619 1585
Email	jason@zimmfor.com

1.6.1 Roles and Responsibilities

Authorized Representative (GreenRaise Consulting GmbH)

- Communicate with and provide instructions to the Verra Registry on behalf of the Project Proponent(s).
- Designate the account into which VCU's may be deposited

Implementation Partner (GreenRaise Consulting GmbH)

- Work in partnership with the Project Proponent(s) to obtain project validation
- Assist with obtaining verified carbon units through verification audits
- Perform project monitoring requirements (including field work and follow-up required reporting)

Project Developer (GreenRaise Consulting GmbH, Zimmfor Management Services Ltd.)

- Develop and provide all required deliverables for project validation/verification including but not limited to:
 - o Project Description Document
 - o Project Monitoring Report
 - o AFOLU Non-permanence Risk Assessment
 - o Completed VCS Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities
 - o Baseline and project carbon modelling
 - o Stakeholder and Community Engagement reference materials
 - o Standard Operating Procedures for project implementation and validation

1.7 Ownership

Lands within the project area are owned by TimberWest and Island Timberlands. Mosaic is the timberlands manager for TimberWest and Island Timberlands, managing their forest resources, forest operations, and forest management planning. Mosaic has been given management directive and therefore consent¹ from the property owners to implement the carbon crediting project.

¹ Consent has been provided and services defined in "Schedule A – Scope of Services" in the "Sales and Services Agreements" between Mosaic Forest Management Corporation, Island Timberlands and TimberWest. Notably, Mosaic is to provide Sales, Agency, Purchasing and Marketing Services and shall act in the capacity as Agent for TimberWest and Island Timberlands.

TimberWest and Island Timberlands have made Management Commitments (as required under the Private Managed Forest Land Act) for Managed Forests: 7, 8, 19, 21, 65, 68, 74, and 76. Managed Forests are composed of parcels of land, with each parcel having a unique Parcel Identifier (PID). PIDs are registered with the Government of British Columbia's Register to Land Titles (according to the Land Title Act) administered by the Land Title and Survey Authority of British Columbia. Each parcel is associated with either TimberWest or Island Timberlands. Samples of specific properties included in the project are provided below. Specific legal title will be provided to the validation body for each land parcel upon request.

Refer to Appendix for the list of project polygons and the corresponding ownership (i.e., Island Timberlands and TimberWest).

Table 3: Supporting Property Ownership Information [sample]

Landowner	Managed Forest No.	Land District	Block Number	Parcel Identifier (PID)
TimberWest Forest Corporation	19	15	1339	008-957-436
Island Timberlands Limited Partnership	74	01	84	008-243-727

1.8 Project Start Date

The project start date is January 1, 2018. As of January 1, 2018, TimberWest and Island Timberlands have curtailed harvesting within the PAI of the project area.

1.9 Project Crediting Period

Project activities were initiated January 1, 2018 and will be completed on December 31, 2047. The project crediting period will be 30 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

BigCoast estimates generating more than 300,000 tonnes of CO₂e per year making it a large project.

Table 4. Project Scale

Project Scale	
Project	
Large project	X

The estimated annual GHG emission reductions/removals of the project are:

Table 5. Estimated GHG emission reductions and removals

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
January 1, 2018 - December 31, 2018	257,210
January 1, 2019 - December 31, 2019	278,225
January 1, 2020 - December 31, 2020	296,167
January 1, 2021 - December 31, 2021	311,440
January 1, 2022 - December 31, 2022	459,004
January 1, 2023 - December 31, 2023	631,586
January 1, 2024 - December 31, 2024	667,997
January 1, 2025 - December 31, 2025	699,012
January 1, 2026 - December 31, 2026	724,948
January 1, 2027 - December 31, 2027	767,099
January 1, 2028 - December 31, 2028	557,145
January 1, 2029 - December 31, 2029	552,487
January 1, 2030 - December 31, 2030	548,830
January 1, 2031 - December 31, 2031	545,174
January 1, 2032 - December 31, 2032	625,977
January 1, 2033 - December 31, 2033	537,809
January 1, 2034 - December 31, 2034	533,702
January 1, 2035 - December 31, 2035	530,462
January 1, 2036 - December 31, 2036	526,688
January 1, 2037 - December 31, 2037	486,707
January 1, 2038 - December 31, 2038	478,325
January 1, 2039 - December 31, 2039	467,350
January 1, 2040 - December 31, 2040	458,304
January 1, 2041 - December 31, 2041	449,667
January 1, 2042 - December 31, 2042	439,673

January 1, 2043 - December 31, 2043	433,831
January 1, 2044 - December 31, 2044	424,380
January 1, 2045 - December 31, 2045	417,097
January 1, 2046 - December 31, 2046	410,706
January 1, 2047 - December 31, 2047	780,657
Total estimated ERs	15,297,660
Total number of crediting years	30
Average annual ERs	509,922

1.11 Description of the Project Activity

BigCoast emphasizes the protection of old forests, culturally significant, and ecologically significant forest lands on Vancouver Island and Haida Gwaii within British Columbia, Canada. The Project Proponent will implement the IFM project by reducing GHG emissions through deferral of timber harvest and other forestry related operations. Ecosystem protection is achieved through the conversion of industrial forests to protected forest, increasing carbon retention and avoiding future GHG emissions from logging operations.

Novel technologies, products or services will not be required for project implementation. BigCoast will be implemented following logged to protected forest conservation principles, which include forest health monitoring, and property supervision. Low levels of timber harvest may be required for forest health maintenance, as deemed necessary. Emissions from forest health management shall be tracked and accounted for in carbon flow projections.

As the Project Proponent, Mosaic will oversee the implementation of the project, including all maintenance activities such as monitoring and subsequent verification events. Currently, no other entities (i.e., communities, other organizations) are directly involved in the implementation of the project, however, other entities could be included in the future as an additional proponent(s) as part of the grouped project.

The project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

1.12 Project Location

The PAI is located within TimberWest and Island Timberlands privately owned forest lands. The geographic project area includes Vancouver Island & Coastal Mainland, and Haida Gwaii. Areas bordering the project area include a mixture of operational forest lands, crown lands, private lands, and municipal boundaries. The current extent of the PAI is described by the geodetic coordinates within Table 6 below, map(s) within Section 3.3 and in the associated KML file located within the Verra Registry.

Table 6 Project geographic boundary

	Extent Coordinates			
Coordinate System	North	South	East	West
GCS_WGS_84	53.8237	48.3803	-123.6	-132.3993

1.13 Conditions Prior to Project Initiation

Ecosystem type: The PAI (which is comprised of multiple polygons (parcels) includes low elevation forests near rivers and estuaries, mid elevation foothills, and sub alpine forests within coastal British Columbia hosts a wide diversity of ecosystems, which vary with elevation. The project includes a gradient of low elevation coastal forests, to high alpine and subalpine mountain ecosystems. Vancouver Island is the most mountainous region of the project area, where forests reach a maximum elevation of 1650m (Green and Klinka 1997).

British Columbia classifies ecosystems into Biogeoclimatic (BEC) Zones. Each zone is further defined using subzones and variants. The BEC classification system is an important tool used by foresters and ecologists to describe site conditions, which influence stand structure, tree and vegetation species present, flora and fauna, and wildlife species. A full list of BEC zones and their descriptions can be found in Table 5 (British Columbia Forest Service 1999). The soils of coastal British Columbia are composed of a broad spectrum, and are from the Podzolic, Brunisolic, Regosolic, Gleysolic, and Organic orders (Keser and Pierre 1973).

Current and historical land-use: The conditions existing prior to the initiation of the BigCoast Forest Climate Initiative are the same as the baseline scenario. Refer to Section 3.4 for a full description of the baseline scenario.

The geographical extent of BigCoast contributes to a wide range of pre-project site conditions. The selected areas are within Mosaic's operational timber harvest land base and were previously managed for timber harvest.

Historical land use surrounding the project area is primarily related to timber harvest operations. TimberWest and Island Timberlands have maintained timber harvest operations on coastal British Columbia for more than 20 years. The Project Proponent manages the harvesting operations of both entities on private lands and manages a replaceable forest license volume in the Great Bear Rainforest, the North Island Timber Supply Area, and Tree Farm License 47. In addition to harvest operations, the Project Proponent maintains several campgrounds available for public use within their lands.

The land within the project area has not been cleared of native ecosystems within 10-years of the project start date.

Table 7: Biogeoclimatic zones within the project activity instance

BEC Zone	Distribution	Climate	Vegetation
CDFmm	The CDFmm is restricted to low elevations along southeast Vancouver Island from Bowser to Victoria, the Gulf Islands south of Cortes Island, and a narrow strip along the Sunshine Coast near Halfmoo	The CDFmm lies in the rainshadow of the Vancouver Island and Olympic mountains resulting in warm, dry summers and mild, wet winters. Growing seasons are very long and feature pronounced water deficits on zonal and drier sites. The CDFmm represents the mildest climate in Canada.	Forests on zonal sites are dominated by Fd, as well as Bg and Cw. The understorey is dominated by salal, dull Oregon-grape, ocean-spray, and Kindbergia oregana. Less prominent species include baldhip rose, snowberry, western trumpet honeysuckle, vanillaleaf, and Rhytidadelphus triquetrus. Drier sites are characterized by the presence of Garry oak and arbutus, as well as numerous members of the lily family.
CMAunp	the Coastal Mountain-heather Alpine Zone occurs along the windward spine of the Coast Mountains and the mountains of Vancouver Island and Haida Gwaii where the snowpack is deep and summers are moderated by maritime influences. Alpine typically begins at 1600m in the south of the province.	Temperatures are cool for most of the year, with much wind and snow. Temperatures remain low throughout the growing season. Mean annual temperatures range from 0 to 4 C, and average monthly temperatures stay below 0 C from 7 to 11 months of the year. Alpine zones receive heavy precipitation, most of it as snow.	The treeline in this environment is lowered by heavy and prolonged snow cover and can be as much as 900m lower than in the alpine of comparable latitudes in the dry interior. Vegetation in the alpine can be lush near the treeline but becomes sparser with elevation. At the treeline, the interface between the subalpine parkland and the true alpine occurs, creating a mosaic of stunted "krummholz" tree patches and meadow or alpine tundra. Treeline trees are mostly mountain hemlock, yellow-cedar, and subalpine fir. Mountain-heathers are common. Lower alpine elevations include an abundance of alpine and montane species.
CWHmm1	The CWHmm1 is mainly restricted to Vancouver Island where it occurs along the leeward side of the Vancouver Island Ranges above the CWHxm subzone. It also occurs at higher elevations on Quadra, Sonora, and West and East Thurlow islands. Elevational limits range from approximately 450 to 700 m (above the CWHxm if	The CWHmm1 has climatic conditions intermediate between the CWHxm and the CWHvm subzones. It has moist, mild winters and cool but relatively dry summers. Historically, dry summers have occasionally resulted in stand-replacing wildfires, which have contributed to the abundance of Fd in this variant. Climatic data are unavailable for the CWHmm1.	Forests on zonal sites are dominated by Hw, Ba, and Fd. Shrub layers commonly include red huckleberry, Alaskan blueberry, and, to a lesser extent, salal and dull Oregon-grape. Hylocomium splendens, Rhytidadelphus loreus, and Rhytidopsis robusta dominate the well-developed moss layer.

BEC Zone	Distribution	Climate	Vegetation
	present), although it extends lower in isolated cases.		
CWHmm2	The CWHmm2 occurs at higher elevations along the leeward side of the Vancouver Island Ranges, below the MH zone. Elevational limits range from approximately 700 to 1100 m.	Compared with the submontane variant, the CWHmm2 has cooler temperatures, shorter growing seasons, and heavier snowfall, with snowpacks persisting throughout the winter. Like the submontane variant, the CWHmm2 has a growing season water deficit from the rainshadow effect of the Vancouver Island mountains. Climatic data are lacking for this variant.	: Forests on zonal sites are dominated by Hw, Ba, Fd, and minor amounts of Yc and Hm (more common at upper elevations and on wetter sites). The understorey features abundant Alaskan blueberry and lesser amounts of salal, oval-leaved blueberry, and black huckleberry. <i>Rhytidiopsis robusta</i> , <i>Rhytidiadelphus loreus</i> , and <i>Hylocomium splendens</i> dominate the well-developed moss layer.
CWHvh1	The CWHvh1 occurs in hypermaritime areas of the south coast. It is restricted to a narrow coastal fringe on the outer coast of Vancouver Island from near Port Renfrew to Quatsino Sound. It widens north of Quatsino Sound, covering the northern end of Vancouver Island. The elevational limits range from sea level to approximately 200 m (higher in the north).	The CWHvh1 is cool with very little snowfall. The proximity to the Pacific Ocean moderates' temperatures throughout the year. Fog, cloud, and drizzle are common throughout the year. Precipitation varies widely in this unit, with lowest values occurring in the local rainshadow on the northeastern part of Vancouver Island at Bull Harbour.	Forests on zonal sites are dominated by Hw, accompanied by Ba, Cw, and minor amounts of Yc (in the northern part). Major understorey species include salal, Alaskan blueberry, red huckleberry, deer fern, <i>Hylocomium splendens</i> , and <i>Rhytidiadelphus loreus</i> . Evergreen huckleberry is a minor species on zonal sites, but more common on drier sites. Bog ecosystems occur commonly on subdued terrain.
CWHvm2	The CWHvm2 occurs at higher elevations, above the CWHvm1. Elevational limits range from approximately 650-1000 m in the south to 450-800 m in the north. It grades into the MH zone above.	The CWHvm2 has a wet, humid climate with cool, short summers and cool winters featuring substantial snowfall. Compared with the submontane variant, the CWHvm2 has cooler temperatures, shorter growing seasons, and heavier snowfall, with snowpacks persisting throughout the winter.	Forests on zonal sites are dominated by Hw, Ba, and, to a lesser extent, Cw, Yc, and Hm. The latter two species become more common with increasing elevation and wetter sites. Major understorey species include Alaskan blueberry, five-leaved bramble, <i>Hylocomium splendens</i> , <i>Rhytidiadelphus loreus</i> , and <i>Rhytidiopsis robusta</i> .
CWHwh1	The CWHwh1 is restricted to Haida Gwaii where it occurs at lower elevations on the leeward side of the Queen Charlotte Ranges. The elevational limits range from sea level to approximately 350 m (250 m approaching the CWHvh2 to the west).	The CWHwh1 has mild, wet winters with little snowfall, and cool moist summers. Occasional warm dry periods during the summer reflect the rainshadow effect of the Queen Charlotte Ranges. The overall temperature regime is mild due to the moderating effect of the Pacific Ocean. Cloud and fog are frequent throughout the year.	Forests on zonal sites are dominated by Hw, Cw, and Ss. Mosses dominate the understorey with <i>Hylocomium splendens</i> , <i>Rhytidiadelphus loreus</i> , and <i>Rhizomnium glabrescens</i> occurring most commonly. The herb and shrub layers are sparse, probably due to heavy deer browsing. Very old successional stages are increasingly dominated by Cw. Subdued terrain on the Queen Charlotte 61 Lowlands and eastern

BEC Zone	Distribution	Climate	Vegetation
			Skidegate Plateau have extensive bogs and nutrientvery poor to - poor, Cw, Hw, salal-dominated stands.
CWHwh2	The CWHwh2 is restricted to Haida Gwaii where it occurs above the CWHwh1 throughout the eastern Skidegate Plateau and eastern Queen Charlotte Ranges. Elevational limits range from approximately 350 to 600 m.	The CWHwh2 is cooler and wetter than the CWHwh1 below it and has greater snowfall and a more persistent snowpack. Low cloud and fog likely influence this variant more than the submontane variant. There are no long-term climate data to characterize this unit.	Forests on zonal sites are dominated by Hw, Cw, and Yc, with Ss occurring less commonly. Minor amounts of Hm may occur but vigour is poor. The understorey is dominated by mosses and liverworts, including <i>Hylocomium splendens</i> , <i>Rhytidiadelphus loreus</i> , and <i>Scapania bolanderi</i> . The herb and shrub layers are sparse, probably due to heavy deer browsing.
CWHxm1	The CWHxm occurs at lower elevations along the east side of Vancouver Island (above the CDF where present) as far north as Kelsey Bay, and on the islands around southern Johnstone Strait. It also occurs inland on Vancouver Island along major valleys from Nimpkish Valley in the north to Cowichan Valley in the south. Elevational limits range from sea level (or above the CDFmm where present) to approximately 700 m. Near the wetter parts of its distribution, the upper limit is lower (e.g., 150 m on Gambier and Bowen islands, and in the Fraser Valley).	The CWHxm has warm, dry summers and moist, mild winters with relatively little snowfall. Growing seasons are long, and feature water deficits on zonal sites.	Forests on zonal sites are dominated by Fd, accompanied by Hw and minor amounts of Cw. Major understorey species include salal, dull Oregon-grape, red huckleberry, <i>Hylocomium splendens</i> , and <i>Kindbergia oregana</i> . Less common species include vanilla-leaf, sword fern, twinflower, and bracken.
CWHxm2	Same as CWHxm1	Same as CWHxm1	Same as CWHxm1
CWHvm1	The CWHvm1 is the most extensive biogeoclimatic unit in the Vancouver Forest Region. It occurs on the windward slopes of Vancouver Island as far south as Jordan River, and on both sides of Vancouver Island north of Kelsey Bay. Its northern limit	The CWHvm1 has a wet, humid climate with cool summers and mild winters featuring relatively little snow. Growing seasons are long. Although precipitation is high, it can vary considerably, from lower values in the local	Forests on zonal sites are dominated by Hw, Ba, and lesser amounts of Cw. The understorey generally features a welldeveloped shrub layer dominated by red huckleberry and Alaskan blueberry, and a well-developed moss layer dominated by <i>Hylocomium splendens</i> and <i>Rhytidiadelphus</i>

BEC Zone	Distribution	Climate	Vegetation
	on Vancouver Island occurs just north of Port Hardy. The elevational limits range from sea level (or above CWHxm or CWHdm if present) to approximately 650 m (600 m on Vancouver Island).	rainshadow of northeastern Vancouver Island (Port Hardy, Port Alice, Coal Harbour, and Alice Lake 58 areas), to the highest values where air masses lift over steep mountains (e.g., Ocean Falls).	lores. Herbs are sparse and include minor amounts of deer fern, five-leaved bramble, bunchberry, and queen's cup. Subdued terrain on the west coast and northern end of Vancouver Island features very old successional stages dominated by Cw, Hw, and salal.
MHmm1	The MHmm1 occurs at high elevations on Vancouver Island and in maritime areas of the mainland coast. The lower elevational limit is between 800 and 1000 m and the upper limit is between 1100 and 1350 m.	The MHmm1 has long, wet, cold winters and short, cool moist summers. Frozen soils are rare due to the insulating snowpack but growing season frosts are common. Total snowfall is high, resulting in substantial snowpacks that can persist into July.	Forests on zonal sites are dominated by Ba and Hm, and, to a lesser extent, Yc. Alaskan blueberry, oval-leaved blueberry, and Rhytidopsis robusta are prominent in the understorey. Vegetation and stand characteristics in the MHmm1 are strongly influenced by local topography, which affects timing and pattern of snowmelt.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

In British Columbia, these lands are subject to the Private Managed Forest Land Act (2003). Lands are categorized based on Section 24 of the Assessment Act, which restricts landowners of large properties (≥ 25 ha and managed as a single unit) of managed forests to the management of their property for forestry and forestry related uses. The Private Managed Forest Land Act sets out forest land objectives for soil conservation, water quality, fish habitat, critical wildlife habitat and reforestation. These objectives prescribe forest management practices and outcomes on private managed forest land, accounting for environmental, social, and economic benefits of forest management. An extensive list of legislation governs forest management activities in British Columbia, which includes but is not limited to the Acts and associated regulations as presented in Table 8: Relevant legislation governing private forest land management

Table 8: Relevant legislation governing private forest land management

Legislation	Description
Assessment Act	The Assessment Act describes the criteria for “managed forest land” status, which separates this class of private land use for taxation purposes. Regulations under this act dictate the minimum forest management activities required for managed forest land certification. Annual reporting of activities and plans are required under these regulations.
Environmental Management Act	This Act regulates the environment including air, land, water, and all other external conditions or influences under which humans, animals and plants live or are developed. It also regulates environmental emergencies and the disposal of wastes. It deals with packaging, containers, permitting, spill prevention and reporting, abandonment, sewerage, contaminated sites (site profiles, investigations, remediation), clean air and emissions.
Hazardous Waste Regulation	This regulation controls the storage, handling, and disposal of special wastes. Some of the requirements include Registration with the Ministry of Environment if sufficient quantities of wastes are generated in a 30-day period; Obtaining a storage permit if sufficient quantities of wastes are generated; Obtaining a consignor identification number, or BCG number if necessary; and Monitoring the quantities of wastes generated and reporting any changes.
Integrated Pest Management Act	This act regulates the use of pesticides. It requires the licensing of sales of pesticides; certification for application and sales; an approved plan including public advertisement and potential response; appeal procedures; inspection and seizure powers.
Land Act	This Act regulates use and sale of Crown land within BC and is administered by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD). Applications for log handling operations are submitted to MFLNRORD, given that most applications require a lease of Provincial foreshore land. MFLNRORD then refers the applications to relevant federal and provincial agencies for comment.
Migratory Birds Convention Act	Implements the Convention on the Protection of Migratory Birds in Canada and the US.
Navigable Waters Act	This Act regulates activity in, around, under and over navigable waters. The Act is administered by Navigable Waters Protection Division, Transport Canada. Navigable waters are defined and listed under the Act.
Plant Protection Act	Protect plant life and the agriculture and forestry sectors by preventing import, export and spread of pests and by controlling or eradicating pests in Canada.
Private Managed Forest Land Act	This act regulates private land designated as Managed Forest. The Acts and regulations provide for permitted uses, protection of key public environmental values of water quality, fish habitat, soil conservation and critical wildlife habitat and a requirement for reforestation. Certain sections of Acts and Regulations for Crown Land apply to Private Managed Forest Lands such as timber marking, fire control and suppression and noxious weeds.
Private Managed Forest Land Regulations	Regulations under the Private Managed Forest Land Act respecting requirements and constraints for management of soil conservation, water quality and fish habitat and respecting requirements and constraints for management of critical wildlife habitat on “identified land”; as well as the administration of the Private Managed Forest Land Council.
Professional Governance Act	The Act provides a consistent framework for governance of self-regulated professions, and to ensure those professions are regulated to protect the public

Legislation	Description
	interest. A self-regulated profession is any profession that is regulated by its members
Species at Risk Act (SARA)	Prevent wildlife species from being extirpated or extinct, provide for recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and manage species of special concern.
The Canadian Environmental Protection Act (CEPA)	Although mostly confined to federal lands and facilities, this act pertains to coastal forest operations in the areas of ocean dumping regulations and navigable waters. Dredgate disposed of at federal marine ocean disposal sites are permitted through this act.
The Fisheries Act	This focus of this Act is to protect the productivity of recreational, commercial and Aboriginal fisheries. S35 requires that no person shall carry on any work or activity that results in the harmful alteration, disruption or destruction of fish habitat. Activities essential to forest harvesting which may involve exceptions of a minor or marginal nature can be carried out only with expressed consent of fisheries officers. Other activities involving more significant alterations may occasionally be approved provided that it includes a plan, which incorporates mitigation resulting in no net loss of habitat.
Transport of Dangerous Goods Act	This act prohibits the handling of dangerous goods (classified under the act) unless specified safety requirements are adhered to. This includes transportation requirements; powers of inspection, detection and removal; and documentation.
Transportation of Dangerous Goods Act	Safety requirements related to the handling and transport of hazardous substances (e.g., fuel).
Vancouver Island Land Use Plan (VILUP)	A higher-level plan covering Vancouver Island (including Quadra Island) that became effective in 2000.
Water Sustainability Act	This act regulates the use of water in the province. It allows for the issuing of water licenses and grants approval authorizing changes in or about streams such as crossing structures.
Wildfire Act	This Act regulates the requirements for reporting and suppressing fire, equipment and patrol requirements and shutdown and reduced work criteria.
Wildlife Act	This Act regulates activities that may impact bird's eggs and/or nests. A person commits an offense if the person possesses, takes, injures, molests or destroys a bird or its egg, or the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl.

Municipal Legislation

Lands within municipal boundaries fall under local bylaws if they do not have Managed Forest status. Lands outside incorporated municipalities fall under zoning and other regional district bylaws. Bylaws fall under the Provincial Local Government Act. Project activities do not disobey any applicable bylaws as outlined under the Provincial Local Government Act.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

A portion of the project area was previously registered under the Strathcona Ecosystem Conservation Project. This carbon project followed the British Columbia Forest Carbon Offset Protocol 1.0 (FCOP 1.0) and was classified as an Improved Forest Management Project. Project activities followed the BC Emissions Offset Regulation. The areas that were verified (2011-2012) and have an offset permanence agreement with the Pacific Carbon Trust have been excluded from BigCoast. FCOP 1.0 is no longer a recognized protocol and the Strathcona Project has not been grandfathered under the current legislation.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related credit, including renewable energy certificates,

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The Project Proponent will contribute to sustainable development as defined by and tracked against the United Nations Sustainable Development Goals (SDGs). The Project Proponent's contribution to (at minimum) SDGs 6 (Clean Water and Sanitation), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Under Water) and 15 (Life on Land) is illustrated through the following initiatives:

1. Group Activity 1 - Sustainable Forest Management:

This relates to on-going implementation, maintenance, and certification to a recognized third-party forest certification standard on privately owned forestlands. The certification requires measures to be implemented to protect water quality, biodiversity, wildlife habitat, species at risk and forests with exceptional conservation value. This sustainable forest management certification requires on-going monitoring, reporting and annual external audits (registration and surveillance) by accredited third parties.

2. Group Activity 2 - Climate Improvement Initiative:

As outlined in this Project Description Document, the Project Proponent intends to implement a carbon offset project to create greenhouse gas (GHG) emission reductions and removals by converting privately owned operational forest lands to protected forest lands. By stopping timber harvest within the PAI, an estimated 15,000,000 tonnes of carbon dioxide equivalent (tCO₂e) will be reduced from the atmosphere during the life of the project. This project requires on-going monitoring, as well as validation/verification audits by accredited third parties.

3. Group Activity 3 – Aquatic Ecosystem Enhancement Initiative:

This initiative relates to water and drainage quality, and watershed management. Continued quality standards and certification occurs through recognized third-party qualified inspections with measures implemented to protect water quality and drainage improvements at working facilities, and ecosystem biodiversity through watershed protection measures and ongoing support for fish stewardship and research projects for the enhancement of salmon stocks.

Nationally stated sustainable development priorities have been communicated by the Government of Canada via their Sustainable Development website² and specifically within the draft Federal Sustainable Development Strategy (2022 to 2026). While this draft strategy intends to outline targets and measures with a focus on the environmental aspects of the 17 SDGs, it is directed at 99 organizations across the federal government. As the Project Proponent is not an organization of the federal government, no monitoring or reporting provisions relating to BigCoast's potential contributions to achieving nationally stated sustainable development properties apply.

1.17.2 Sustainable Development Contributions Activity Monitoring

BigCoast activities implemented during this monitoring period results in SD contributions and benefits by providing plant and wildlife biodiversity through ecosystem management and conservation; climate improvement by reducing and removing GHGs with the implementation of a LtPF carbon project and improves water quality and associated biological dependencies via watershed protection and measures.

² <https://www.canada.ca/en/services/environment/conservation/sustainability/federal-sustainable-development-strategy.html>

Table 9: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	6.6	<u>Clean Water + Sanitation</u> : Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes	Implemented activities to increase	Protect watershed areas (ha) from degradation from activities, including timber harvesting, road construction activities	Contribution to improvement of water quality and watershed drainages through protection of 44,022 Ha
2)	12.2	<u>Responsible Consumption + Production</u> : Achieve the sustainable management and efficient use of natural resources	Implemented activities to increase	Volume harvested is <= the Annual Allowable Cut (or within the acceptable range and consistent with long term modeling)	Forestland is certified to a recognized third-party sustainable management standard
3)	13.0	<u>Climate Action</u> : Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	By conserving 44,022 ha of temperate boreal forest, the BigCoast Carbon Project has prevented the release of 1.1 million tonnes of carbon into the atmosphere during the monitoring period	Prevent the release of an estimated 15 million tonnes of carbon into the atmosphere
4)	14.0	<u>Life Under Water</u> : Number of fish (anadromous) stewardship projects.	Implemented activities to increase	By supporting the number of (+10) aquatic stewardship projects within the project area.	Support +10 fish (anadromous)/aquatic stewardship projects.

5)	15.2	<u>Life on Land</u> : Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	Implemented activities to increase	Promote reforestation by other landowners through seedling donations from own stock.	Number of seedlings donated to landowners from 2017-2022 >+100,000
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1.18 Additional Information Relevant to the Project

1.18.1 Leakage Management

The Project Proponent will provide evidence that no compensatory harvesting has been initiated to account for lost timber volumes incurred during the carbon project. Supporting evidence may include harvest volume summaries or financial statements to show that no additional land acquisition will be made with the sole intention of replacing harvest which has been deferred through the creation of BigCoast.

Further information regarding a leakage monitoring plan will be provided within the Section 5.3.

1.18.2 Commercially Sensitive Information

Commercially sensitive information has been excluded from the public version of the project description. This information pertains to the following:

- Section 2.4; Due to confidentiality concerns, comments associated with the Local Stakeholder Consultation process will not be made publicly available, however were provided to the VVB at the time of validation and will be made available at subsequent verification events.
- Section 4.3.2.; Table 16: Project Proponent's Market and product table; Table 18: Re-assessment of markets; Table 19: Percent of market supplied.
- Section 4.3.2; Barrier Analysis (Step 2 commentary)
- Section 4.3.1; Step 1 reference to gross hectares and Timber Harvesting Landbase (hectares)
- Section 5.3.2; Table 21: Project Plot Geographic Locations
- Appendix 1; Table 2: Ecosystems and Disturbance Types for Mosaic Lands

1.18.3 Further Information

As part of Mosaic's project development efforts, Project Extension Agreements have been reached to enable important Indigenous research on the project lands and marine research adjacent to project lands in the region through funding derived from the sale of VCU's from this project. These agreements

with Makeway Charitable Society – Indigenous Protected & Conserved Areas (IPCA) Innovation Program and the Pacific Salmon Foundation extend cultural, ecological and marine climate research programs by providing funds that these two not-for-profit organizations will leverage for their existing programs.

No further information beyond what has been provided within the sections of this project listing document have bearing on the eligibility of the project, the net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

There are no known or anticipated potential negative and socio-economic impacts related to BigCoast specifically due to the nature of the initiative being the retention of natural forests. Following the procedures described within the GreenRaise, Greenhouse Gas – Stakeholder Consultation + Engagement (SOP) a Life Cycle and Aspects analysis was conducted. Refer to Section 2.5 below for a full description of this process.

2.2 Local Stakeholder Consultation

Local stakeholder consultation was conducted for a 30-day period from April 21, 2022, and May 21, 2022, prior to project validation. Consultation was conducted both via electronic documents delivered by email, numerous group information sessions, as well as an in-person via “Town Hall” meetings held on:

- April 25, 2022, within the community of Qualicum, BC;
- April 26, 2022, within the community of Duncan, BC;
- May 4, 2022, within the community of Port Alberni, BC; and
- May 10, 2022, within the community of Haida Gwaii.

Meetings were organized by the Project Proponent and attended by the Project Developer and Implementation Partner. Attendance was taken at the Town Hall meetings and is kept on file. Project information relating to the design and implementation, any risks, costs or benefits to local stakeholders, all relevant law and regulations covering workers’ rights in Canada, and the validation and verification process was provided via the GreenRaise website (<https://green-raise.com/projects/>). Links to the Verra Project Registry are also provided on the GreenRaise website. If required throughout the life of the project, any additional information that is required to be communicated to local stakeholders will follow the same process of electronic correspondence via email and information provided via the GreenRaise website.

Online forms were made available on the GreenRaise website and comments submitted through BigCoast or proponent websites were used to collect stakeholder comments and feedback. Comments received through other means (i.e., Town Halls or direct emails) were collected and stored within the Project Proponents Salesforce³ database.

The feedback forms will remain accessible to the public throughout the lifetime of the project, allowing for continual stakeholder engagement.

Response, and any required project design updates to the project design relating to comments received from Stakeholders were also tracked. All consultation information will be made available to the VVB during project Validation and Verification. Refer to the GreenRaise GHG –Stakeholder Consultation + Engagement SOP for additional details relating to Stakeholder consultation processes.

³ <https://www.salesforce.com/ca/>

To date, 11 comments were received through the local stakeholder consultation process. These comments have been summarized, along with the response from the project proponent and will be made available to the VVB during the validation audit. For privacy reasons, public comment information will not be shared publicly.

2.3 Environmental Impact

An environmental impact assessment was not required for BigCoast.

2.4 Public Comments

Due account of all public comments received was completed by the project proponent. No comments were received during the Verra public comment period. As stated above, all comments, and responses (associated with the Local Stakeholder Consultation process), are kept on file. Due to confidentiality concerns, comments will not be made publicly available, however were provided to the VVB at the time of validation and will be made available at subsequent verification events.

2.5 AFOLU-Specific Safeguards

Refer to the GreenRaise GHG – Stakeholder Consultation + Engagement SOP for details relating to the process used to determine local stakeholder identification. Additionally, the SOP outlines the Life Cycle and Aspect Analyses used to determined risks to local stakeholders and their resources.

Table 10 below outlines the identified aspects, impacts, potential risks, risk category (based on Table 1 within the GreenRaise SOP), risk ranking (based on the Risk Ranking Matrix within the GreenRaise SOP), affected stakeholder category and mitigation measures applied (if any).

Table 10: Aspects Analysis Results

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (Implemented by project proponent)
Halting/ reduction of harvesting activities: Logged to Protected Forest (LtPF),	Reduced/ no requirement for harvesting labour	Loss of income/ livelihood	Loss of income to local communities could result in the degradation of local communities (i.e., reduction in community resources, loss of community members due to moving, etc.). (Social, Economic)	Social/ Socio economic	Moderate – Project Proponent will not be halting all operations, only a portion of operations within the project area.	Project Proponent will continue to offer employment opportunities on the remainder of their forest lands.
	Reduction/ no requirement for energy (fuel) consumption	Loss of income/ livelihood	Loss of income to local economy due to reduced need for fuel. (Social, Economic)	Social/ Socio economic	Low – Project Proponent will not be halting all operations, only a portion of operations within the project area	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (Implemented by project proponent)
	Reduction of fuelwood produced	Loss of wood for heating/ fuel purposes	Loss of access to fuel source for home heating (Social)	Social/ Socio economic	Low – Continued harvests in areas outside of the project areas are intended to produce fuelwood for local communities.	
	Public Access reduced or denied	Public recreation opportunities reduced or denied	Increase in illegal trespass instances. Reduced public health (mental and physical) due to reduced access to recreation (Social, Economic)	Social/ Socio economic Traditional/ Human Rights	Low – Public access will not be reduced in project scenario	
		Public access for foraging/ hunting purposes reduced or denied	Increase in illegal trespass instances. Reduced access to food sources (Social, Economic)	Social	Low – Public access will not be reduced in project scenario	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (Implemented by project proponent)
	Reduction in harvesting/ controlled burns for purposes of fire prevention	Increase risk of forest fire	Local communities exposed to higher risk of forest fire. Adjacent forest owners at risk of commodity loss due to forest fire spread. (Social, Economic, Environmental, Forest Agencies).	Environmental	Low – Project Proponent does not utilize controlled burns. Fire hazard assessments will continue to be conducted in areas where annual monitoring is conducted	
	Complete termination of project area maintenance	Road failure	Increased landslide risk to local communities. Watershed/ water quality degradation due to landslides and lack of sediment control. Loss of access to adjacent forest lands due to road failure. (Social, Economic, Environmental, Forest Agencies)	Environmental	Low – Project Proponent will continue maintenance of the project area (i.e., project area is included within Project Proponent's managed forest lands.	

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (Implemented by project proponent)
		Pest or Disease Outbreak	Spread of disease to local community forests/ adjacent forest lands. Watershed/ water quality degradation due to transition to low productivity stands (Social, Economic, Environmental, Forest Agencies)	Environmental	Low – annual monitoring along with continual pest management within project area will continue to occur.	
		Public safety	Increase in accident or injury within project area accessible to public (Social)	Social/ Socio - economic	Low – public access will not change due to the project scenario	
	Property rights are undefined/ disputed	Loss of property rights	Project encroaches on private property Project encroaches on government property Project relocates people off their lands (Social, Economic)	Legal Social/ Socio economic	N/A – Project Proponent property rights have been verified and are not disputed	Additional measures: refer to <i>Respect for Local Stakeholder Resources: Property Rights (GHG Safeguards SOP)</i>

Activity	Aspect	Impact	Potential Risk to local Stakeholders (Stakeholder Category)	Risk Category	Risk Rating and Justification	Mitigation Measures (Implemented by project proponent)
	Participation in project design, implementation, and/or consultation	Safety of local stakeholders	Increased risk to stakeholder safety due to opposing opinions, cultural/religious differences, land holder grievances or disputes, government or local oppression of freedom of expression. (Social, Research Institutes and Universities)	Social/ Socio economic	Low – Refer to Universal Control; There is no evidence of the suppression of freedom of speech within Canada.	Universal Control = All stakeholder contact information (Name, Address, etc.) will be kept confidential. Stakeholder responses will be number coded as to keep public record of responses anonymous.

2.5.1 Grievance Redress Procedure

GreenRaise has developed a Grievance Redress procedure which is outlined within the GHG – Stakeholder Consultation + Engagement SOP. Similar to the process for Stakeholder Consultation, the Grievance Procedures as well as a Grievance Submission Form are posted on the GreenRaise website (<https://green-raise.com/projects/>). All grievances submitted to GreenRaise will be tracked utilizing the Grievance Record Database.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The VM0012 Improved Forest Management in Temperate and Boreal forests (LtPF) v1.2 methodology has been selected for project implementation. Additional tools utilized include:

- AFOLU Non-Permanence Risk Tool: VCS Version 4 (Procedural Document, 19 September 2019)
No additional application conditions are required through the use of this tool.
- VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry, and Other Land Use (AFOLU) Project Activities – Version 3.0, Sectoral Scope 14.
This tool is applicable under the following conditions:
 - AFOLU activities are the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced. The project activities do not violate any legislation.
- The use of this tool to determine additionality requires the baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity. Section 3.5 provides the stepwise approach and eligibility requirements, VCS Module VMD0033 - Estimation of Emissions from Market Leakage. Through the use of the Module, no additional applicability conditions are required (refer to Section 4)

3.2 Applicability of Methodology

Table 11 Compliance with VCS VM0012 Methodology Criteria

	Summarized Methodology Applicability Criteria	BigCoast Climate Initiative – Project Fit
1.	Project meets criteria for IFM-LtPF projects	Project Proponent meets specified criteria by voluntarily protecting privately owned management forest lands within the project area.
2.	Project is located in Temperate or Boreal Domain Global Ecological Zones and meet Tier III inventory and data requirements	Project Proponent lands are located in the Temperate Ecological Zone. Project Proponent utilizes detailed site level inventory meeting Tier III criteria.
3.	Project meets VCS Standard requirements for ownership	Project Proponent can demonstrate Proof of Right and Right of Use.

	Summarized Methodology Applicability Criteria	BigCoast Climate Initiative – Project Fit
4.	Annual illegal, unplanned and fuelwood removals are <5% of total annual harvest levels	Project Proponent has no illegal or unplanned harvesting and, de-minimis fuelwood removals
5.	No managed peatland forests in project	The project areas do not contain managed peatland forests ⁴
6.	Total percentage of wetlands in project area not expected to change due to project activities	Project Proponent will not materially alter the percentage of wetlands on the project area through project activities ⁵
7.	No activity shifting leakage to other lands owned or managed by project proponents at the start of the project	Project Proponent can demonstrate that activities are not shifted to other lands they own or manage by incorporating the project area within their forward-looking forest management plans but choosing to defer harvest. This assessment process will allow Project Proponent to analyze their forest management practices in a “business as usual” perspective throughout the lifetime of the project, and therefore avoid activity shifting leakage.
8.	Project does not include non-de minimis application of fertilizer in the project scenario	Project Proponent will not include any application of fertilizer in the project area

3.3 Project Boundary

Table 12: BigCoast Forest Climate Initiative Project Sources, Sinks, and Reservoirs

Source	Gas	Included?	Justification/Explanation
Baseline Fuel Combustion by Vehicles/Equipment	CO2	Yes	Source – Carbon emissions from harvesting equipment, log transport, and primary forest product manufacturing are listed as being an optional inclusion within VM0012 and will be included in the project.

⁴ Substantiated by the definition of peatland forests, GIS Analysis, Field Verifications, Productive Forest Land Base (PFLB) classification and Academic research data.

⁵ The PAI only contains polygons classified as Productive Forest Land Base (PFLB). PFLB is calculated by removing non-forest and non-productive areas. As non-productive area have been defined to include wetlands and area with less than a prescribed volume of timber, and are excluded from the project, BigCoast will not materially alter the percentage of wetlands on the project area.

Source		Gas	Included?	Justification/Explanation
	Above Ground Biomass (Live)	CO2	Yes	Sink – Biomass re-growth after harvest disturbance Source – Carbon flows resulting from timber harvest removals and adjacent biomass impacts during operations (shifted to other carbon pools) Source – Emissions from mortality and decay in remaining forests.
	Below Ground Biomass Pool (Live and Dead)	CO2	Yes	Sink – Biomass re-growth after forest management activities Source – Carbon flows resulting from forest management harvesting removals (shifting to other carbon pools) Source – Emissions from mortality and decay in remaining forests (shifted to other carbon pools)
	Dead Wood Pool	CO2	Yes	Sink – Dead snags, course branches and stems before and after forest management activities Source – Decay of deadwood pool
	Wood Products Pool	CO2	Yes	Sink – Carbon in permanent storage in harvested wood products Source – Emissions from decaying wood products
Project	Fuel Combustion by Vehicles/Equipment	CO2	Yes	Source – Carbon emissions from industrial equipment are expected to be minimal due to low levels of conservation harvesting for forest health maintenance.
	Above Ground Biomass (Live)	CO2	Yes	Sink – Biomass re-growth after harvest disturbance Source – Carbon flows resulting from timber harvest removals and adjacent biomass impacts during operations (shifted to other carbon pools) Source – Emissions from mortality and decay in remaining forests.

Source		Gas	Included?	Justification/Explanation
	Below Ground Biomass Pool (Live and Dead)	CO2	Yes	Sink – Biomass re-growth after forest management activities Source – Carbon flows resulting from forest management harvesting removals (shifting to other carbon pools) Source – Emissions from mortality and decay in remaining forests (shifted to other carbon pools)
	Dead Wood Pool	CO2	Yes	Sink – Dead snags, course branches and stems before and after forest management activities Source – Decay of deadwood pool
	Wood Products Pool	CO2	Yes	Sink – Carbon in permanent storage in harvested wood products Source – Emissions from decaying wood products
Sources Excluded from the Baseline and Project Scenarios				
Excluded	Above-ground Non-Tree Biomass (Live)	CO2	No	Sources and sinks are <i>de minimus</i>
	Litter Pool	CO2	No	Litter is a short-lived transition pool, and differences between the project and baseline are <i>de minimus</i> over time.
	Soil Carbon Pool	CO2	No	Soil carbon is a reservoir of long-lived carbon storage. Changes to soil carbon from harvesting are assumed to be <i>de minimus</i> .

Refer to the project location maps, located below.

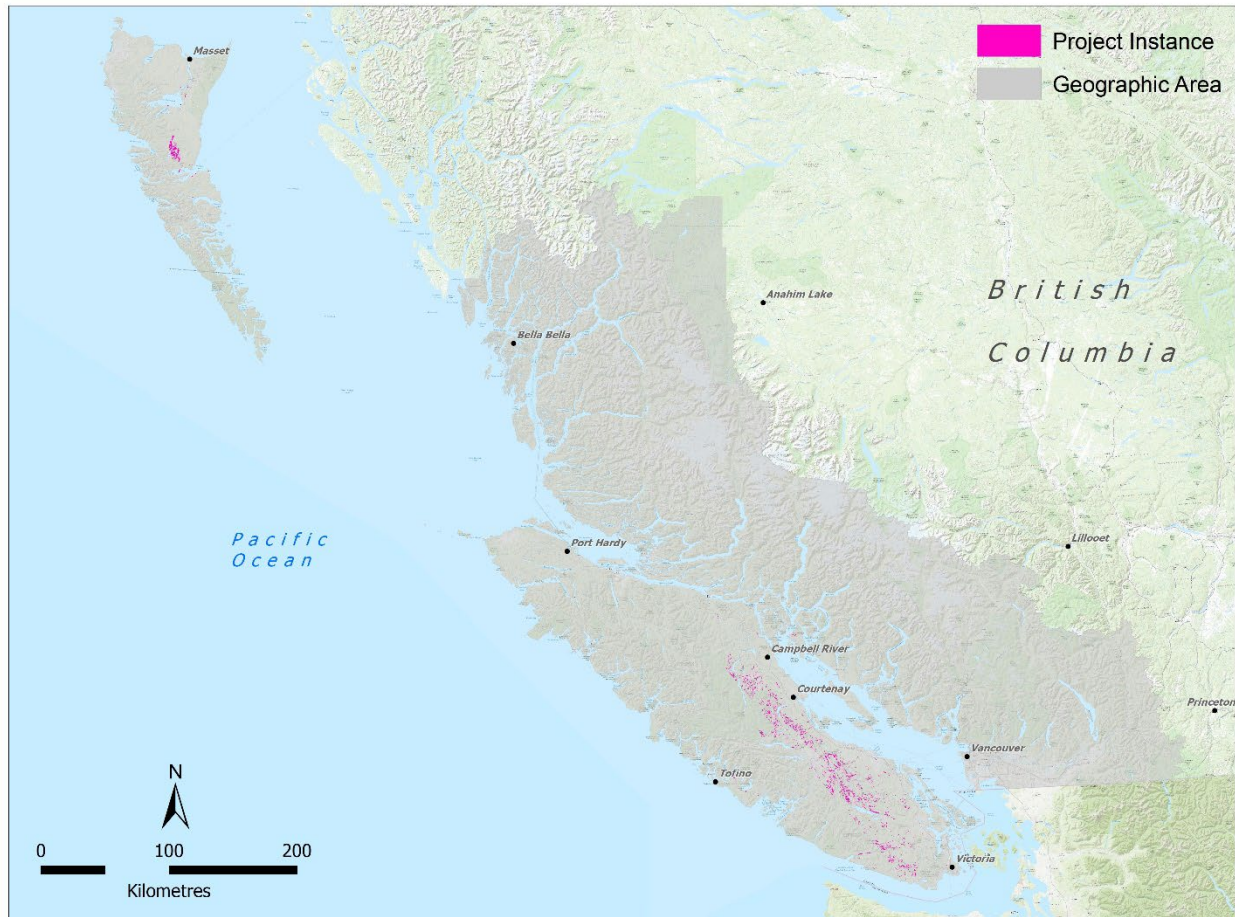


Figure 1 BigCoast Project Area

3.4 Baseline Scenario

3.4.1 STEP 1 – Identify Plausible Alternative Baseline Scenarios to the VCS Activity

BigCoast identified four potential baseline scenarios which were evaluated in the baseline selection process.

1. Historical Practice

The VCS standard and VM0012 methodology require that the project proponent assess historical practice as a baseline scenario in Step 2a. Harvest operations on Project Proponent's privately owned forests are largely driven by site productivity and market demands. Woodstock Net Present Value (NPV) models are used to create forest harvest projections. Model outputs are privileged information and will not be shared with the public.

Woodstock model outputs created for Island Timberlands plan a steady state harvest in both old forests and second growth stands. TimberWest model outputs are influenced heavily by market demands and fluctuate over time. Harvest rates in old forests and second growth stands have been less than projected from 2018 – 2021 due to the company managing for carbon stands. The projected historical harvest rates have been averaged and used as the baseline harvest rate for the first 10 years of the project period. The baseline will be reassessed (at least) every 10 years.

2. Common Practices

The common practice scenario is to maximize the allowable timber harvest from the forest based on market demands. Timber harvest projections are created to forecast timber harvest and revenues. Forecasts methods differ, in that they can be created annually or for several years at a time. As separate entities, TimberWest and Island Timberlands have used both methods of timber harvest projection. Harvest projections which extend several years may use a steady state harvest method where the harvest rate is fixed throughout the projection period.

As private landowners, forest management on Island Timberlands and TimberWest lands are governed under the Private Managed Forest Land Act (2003). This legislation includes guidelines and constraints for soil conservation, water quality objectives, and fish and wildlife habitat maintenance. The common practice harvest scenario for privately managed forest lands would emphasize the harvest of high value stands before moving to lower value stands. An example of this would be a targeted harvest of high value old forests stands over a 25-year period, then shifting to lesser value second growth stand. Front loading high value timber harvest allows private forest owners to satisfy market demands.

3. Land acquisition for conversion to real estate development

An alternative baseline scenario would be to sell the lands within the project area to gain financial returns from the development and sale of these properties. Some portions of the project area are adjacent to residential areas, making them suitable for primary and secondary residences or industrial developments. This scenario emphasizes maximizing real estate opportunities within best use areas. These areas include shorelines along lakes and rivers, and properties adjacent to villages, towns, and cities.

4. Acquisition for conversion to conservation lands

The last potential baseline scenario is the acquisition of the forest for conservation purposes. This scenario is representative of or comparable to the project scenario without carbon crediting benefits. There is no credible market-based business model for this baseline scenario to provide financial returns for private investment capital as there are no material revenue returns from conservation activities like the project scenario. The inclusion of this scenario meets element 2.1.1 a), item ii) in the VCS Additionality Tool VT0001.

The italicized text below indicates VM0012 methodology or VCS requirements in the baseline scenario selection. Each prospective baseline scenario meets the following selection scenario eligibility criteria, except where noted and excluded:

1. *Including activities and areas where forests remaining as forests* – this criterion eliminated the potential Baseline Scenario 3 “Acquisition for conversion to real estate development lands”.
2. *Comply with legal requirements for forest management and land use in the area* – all remaining baseline scenarios meet the minimum practice requirements of either the Private Managed Forest Land Act or the Provincial Municipal Bylaws and requirements.
3. *Demonstrate that the “projected baseline scenario environmental practices equal or exceed those commonly considered a minimum standard among landowners in the area” (Voluntary Carbon Standard, 2008a)* – all the prospective baseline scenarios comply with or exceed minimum environmental requirements and performance of landowners in the area.

3.4.2 Step 2 – Selection of a Single Plausible Baseline Scenario for the Project

Project proponents shall select a single plausible baseline scenario for the project using the following steps:

3.4.3 Step 2a – The Historical Baseline Scenario – based on historical operating practices on the property:

2a.1 The project proponent has at least 5 years historical harvest level data history.

Timber harvest projections for the project area were created by the Project Proponent annually since 2017. The VM0012 methodology states that “projects may use a forward-looking forest management plan as the historical baseline data”. The annual harvest volume has been determined by averaging forward looking harvest volumes. A breakdown of harvest area among old and second growth forests is provided below. The gross project area is 44,022 ha, with a commensurate annual harvest reduction over the 30-year project period.

Table 13. Breakdown of project area by forest type

Area (ha)	Type
35,638	Old Forest (>121 years)
8,050	Second Growth (40-120)
335	Non-Productive
44,022	Total

The baseline scenario established on actual property harvest history has been selected as the project proponent has at least 5 years historical harvest level data history. Step 2b and 2c will be omitted due to the acceptance of the historical baseline scenario in Step 2a.

3.4.4 Step 3 – Additionality Test

The project is additional as per Section 3.5 in a manner consistent with the baseline selection method.

3.5 Additionality

The project uses the Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities:

This project meets the eligibility requirements of this tool as:

1. The project activities are not in violation of any applicable law;
2. The project employs a stepwise method to determine the most plausible baseline scenario, which is consistent with the application of this tool.

3.5.1 Step 1a – Identification of plausible baseline scenarios

1. Historical Practice (selected baseline scenario)
2. Common Practice
3. Acquisition for conversion to real estate development lands
4. Acquisition for conversion to conservation lands

3.5.2 Step 1b – Legal tests

All plausible baseline scenarios could be undertaken within the legal requirements of British Columbia's Private Managed Forest Land Act and are congruent with private forestland management in Canada.

3.5.3 Step 1c – Selection of Most Plausible Baseline Scenario

See Section 2.4 for description of the baseline selection process.

The outcome of the selection process is to select the "Historical Practice" using the forward-looking forest management plan.

3.5.4 Step 2 – Investment Analysis

In general, the project scenario is less financially attractive than the alternative baseline scenarios. As a Logged to Protected Forest project, the project scenario for BigCoast generates no material financial or economic benefits other than VCS related income, and therefore is suitable for Option 1 – Simple Cost Analysis

3.5.5 Investment Analysis – Option 1 Simple Cost Analysis

Within the PAI, financial benefits can only be produced through revenue associated with VCS related income. No harvesting is to occur, and no material income is being generated from the PAI (i.e., non-VCS related income is \$0.00 CAD). The costs associated with this VCS AFOLU project have been documented (reference in Non-Permanence Risk Report NPV Analysis). As the operating costs are not relevant to the demonstrating additionality (rather it is the demonstration that no financial benefits other than VCS related income exists), the operating costs have not been include in the Project Description & Monitoring Report.

It is acknowledged that the Project Proponent's forestlands have alternate sources of revenue in addition to timber harvest operations (i.e., real estate, firewood permits & campgrounds) that could be used to offset any additional costs incurred by the implementation of the carbon project. These revenue sources are outside of the PAI and can be considered *de-minimis* and are therefore not considered.

As BigCoast's only material commercial revenue and profit opportunity is from the sale of VCU's. Additionality assessment Options 2 and 3 are not considered further because there is no reasonable alternative business model for a private entity to maintain this land for the purposes which achieve similar emissions reductions, given the high acquisition cost and lack of revenue options from conservation activities without carbon financing. Carbon finance provides the only reasonable revenue opportunity to cover project costs, property management costs, and capital costs in the project scenario.

3.5.6 Step 3. Barrier Analysis (supporting information only)

In addition to the Investment Analysis above, there is a clearly related applicable barrier, described below:

3.5.7 Step 3a – Identify barriers that would prevent the implementation of the type of proposed project activity

There are barriers for AFOLU project activities undertaken and operated by private entities:

Similar conservation activities have only been implemented with grants or other non-commercial finance terms. In this context, similar activities are defined as activities of a similar scale that take place in a comparable environment with respect to regulatory framework and are undertaken in the relevant geographical area. The project activity will be unique in that no similar project activities are currently operational within Coastal British Columbia under the Verified Carbon Standard, The Gold Standard or the Clean Development Mechanism.

3.5.8 Step 3b – Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity).

The other scenarios relating to historic practice and common practice are not affected by the above barrier. Income would come from the harvesting of forests that are slated for conservation in the project scenario. The real-estate development scenario would also not be affected by the above listed barrier. In all scenarios, except the project scenario, financial benefits would be received from the sale of land or fiber from the land. The project scenario is unlikely to produce economic benefits or be financially attractive without financial benefits from the VCS AFOLU project.

3.5.9 Step 4. Common Practice Analysis

BigCoast is the first IFM-LtPF carbon project proposed in the Coastal region of British Columbia and the only VCS forest carbon project under development in Coastal British Columbia to date. Conservation projects in Coastal British Columbia have been completed in the past with private and public money. Examples of these include the S,DÁYES Flycatcher Forest project located on North Pender Island which covers 5.3 ha, and the Salmon River Elk Reserve (24.8 ha). Similar conservation projects completed thus far are much smaller in scale and were created via fundraising efforts.

The Strathcona Ecosystem Conservation Project is the only other carbon offsetting forest conservation project implemented in Coastal British Columbia. This project was initiated by TimberWest Forest Corp. in 2009, in which harvesting activities were ceased on 25,000 ha of private forestland. The project was registered under the BC Emissions Offset Regulation using the British Columbia Forest Carbon Offset Protocol 1.0 (FCOP). The British Columbia FCOP was repealed in 2015, and the Strathcona Ecosystem Conservation Project is no longer seeking verification to generate carbon credits.

There are no comparable projects within the region that could be considered common practice, and which achieve similar scale or employ similar project activities. Similar acquisitions are only achieved with non-commercial funding and capital sources.

Based on the application of this VCS tool, BigCoast is clearly additional based on Investment Analysis.

3.6 Methodology Deviations

No deviations were required in the implementation of the VM0012 methodology.

4 ESTIMATED GHG EMISSIONS REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 Validating Inventory Requirements

BigCoast meets the Valid Starting Inventory Requirements from the methodology (methodology criteria in italics):

1. *Pertaining directly to the entire project area; the inventory data (2021 (updated annually)) covers the entire project area, and meets this criteria.*
2. *Created, updated, or validated <10 years ago; and,*
3. *Documentation is available describing the methods used to create, update, or otherwise validate the starting inventory, including statistical analysis, field data, and/or other evidence.*

The Project Proponents inventory methods and related inventory updates are documented in a series of documents that define the Timber Supply Analysis (TSA) Procedures; which therefore meets the criteria. Further to the above, the Project Proponent is currently in the process of completing a LiDAR and Colour Infrared (CIR) Area Based Assessment (ABA) inventory in 2022. Current work includes Plot establishment and measurement protocols are derived from the BC Change Monitoring Inventory with the goal to validate/ refine the LiDAR data.

4.1.2 Baseline Scenario Area Stratification

STEP 1 - Stratify to create homogeneous units.

The Project Proponent's forest inventory is contained within an extensive Geographic Information System (GIS) dataset. The forest cover polygons are homogeneous based on forest cover species, stand age, productivity class, and other stand attributes including operability etc. The Carbon modeling is specific to the forest lands intended for regulated harvesting.

For modelling purposes, inventory polygons were further refined into Analysis Units (AUs) based on 'Management Types' (defined in TSA Management Types Procedures) and utilized leading species groupings (Hw, HwFd and HwCw), site index (SI) groupings (SI 26 - 30 = medium) and current management class (Managed (second growth) and Unmanaged (old growth/ natural)). Analysis units are described in Table 14. Description of Forest Analysis Units Defined in the Project Area below.

Table 14. Description of Forest Analysis Units Defined in the Project Area

AU #	Gross Area (Ha)	Short Name
2	298	Alder Good (Man)
3	491	Alder Good-Medium (Un-Man)
4	342	Alder Medium (Man)
5	64	Cedar Good (Un-Man)
6	27	Cedar Good (Man)
7	260	Cedar Medium (Un-Man)
8	94	Cedar Medium (Man)
9	1850	Cedar Poor (Un-Man)
10	69	Cedar Poor (Man)
11	634	Fir Good (Un-Man)
12	851	Fir Good (Man)
13	2712	Fir Medium (Un-Man)
14	1393	Fir Medium (Man)
15	6584	Fir Poor (Un-Man)
16	1414	Fir Poor (Man)
17	561	Hemlock Good (Un-Man)
18	378	Hemlock Good (Man)
19	3270	Hemlock Medium (Un-Man)
20	2678	Hemlock Medium (Man)
21	19001	Hemlock Poor (Un-Man)
22	723	Hemlock Poor (Man)

Note: AU 1 and 99 = 326 ha and consists of project stands (instances) that do not meet the criteria (i.e., Timber Harvesting Landbase criteria) to be assigned an analysis unit but have been included in the project for the sake of spatial contiguity.

STEP 2 – Identify areas eligible for specific management activities.

The BigCoast project area is subject to numerous regulations and legal requirements which governs forest management practices in British Columbia (see sec 1.14). To ensure baseline eligibility, the anticipated area should contribute to future timber volume rates of cut in a harvest plan, and meet the following requirements:

1. Defined as forested areas (vs non-forested areas)
2. Considered merchantable and economically feasible to harvest
3. Not within a legally restricted or protected area

The areas contributing to the baseline projection scenario is consistent with the common forest practices in British Columbia.

4.1.3 Model Selection and Use

The Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) is an inventory-based, yield-curve-driven model that simulates the stand- and landscape-level C dynamics of above- and belowground biomass, dead organic matter (DOM; litter and dead wood) and mineral soil (Kurz et al., 2009). The CBM-CFS3 is a stand- and landscape-level modeling framework that can be used to simulate the dynamics of all forest carbon stocks required under the United Nations Framework Convention on Climate Change. It is compliant with the carbon estimation methods outlined in the guidelines of the Intergovernmental Panel on Climate Change. The model uses much of the same information that is required for forest management planning activities (e.g., forest inventory, growth and yield curves, natural and human-induced disturbance information, forest management schedule, and land-use). The Archive Index Database (AIDB) is the Microsoft Access database behind the CBM-CFS3 that stores default ecological information and parameters pertaining to the forest ecosystems of a country, among other functions.

The (CBM-CFS3) has been adapted, tested, and applied to forests around the world over the last 7 years in support of policy making and scientific research.

4.1.4 Preparation of Stand-level Carbon Curves in CBM

The CBM model was used to create a series of stand attribute curves for each analysis unit to predict/ simulate forest development, merchantable timber volume, and carbon storage and dynamics by carbon pool over time. Existing yield curves/ carbon curves were developed historically by Timberwest and Island Timberlands for their respective land bases and are used with Remsoft/ Woodstock modelling. Data from the Project Proponent's standard Woodstock Model runs were used to set a representative yield curve for all forest polygons within Analysis Units (AUs).

The objective was to calibrate the CBM forest type for each Analysis Unit to generally match the dominant species (mix) found in the carbon monitoring plots which are then being represented by the simplified AU groupings with forest types based on species composition, site productivity and disturbance regime/ harvest history.

Remsoft's Woodstock model, the CBM-CFS3 model and supporting Excel spreadsheets were developed to house the data, and to perform carbon modeling by PAI.

Polygon-based forest inventory data, in a geo-spatial database (TSA dataset), was used to populate the Woodstock Model runs which were completed externally⁶. Corporate operational constraints that reflect the real-world operational environment were applied to produce the Baseline Scenario. These corporate operational constraints, as defined within the TSA Documents, are considered proprietary information but are available for the purpose of validation and verification.

The main driver of the Timber Supply Analysis to date has been to derive a fair value of the timberlands/ enterprise valuation and generate a long-term harvest flow with a positive net present value (+NPV). To accommodate the developing carbon opportunities, a similar process was integrated for the carbon modeling and valuation.

Woodstock results were then used to populate CBM-CFS3 input files (i.e., classifiers, age classes, disturbance types, events, inventory and transitions). Each polygon included sufficient information (Classifiers/ Themes) to allow filtering into its assigned analysis unit (Table 14. Description of Forest Analysis Units Defined in the Project Area).

Theme groupings were used in combination with polygon area to match up the modeled inventory polygon to the correct carbon yield curve data. The CBM-CFS3 derived stand and carbon curves are modeled on an assumed fully stocked representative stand in each AU and applies carbon and merchantable volume outcomes for each polygon based on the applicable allometric formulas. The model includes discrete 'Runs' that represent the project (PRJ - deferred harvest) and specific baseline disturbances/ harvest activities (BSL – harvest).

The Archive Index Database (AIDB) spatial units (BC administrative Unit and Pacific Maritime Ecounit) were used for all analysis unit.

The CBM 'MAKELIST' is a preprocessing program that is used to format the inventory information for input into the CBM-CFS3 and to initialize the DOM carbon pools. These pools include carbon from aboveground and belowground dead tree biomass (e.g., coarse woody debris; litter, fibric, and humic layers; and mineral soil). MAKELIST uses the same algorithms and parameters as the CBM-CFS3 and simulates each stand record through a number of natural disturbance cycles (grow, burn, grow, burn, etc.) until the slow DOM carbon pool at the end of two successive rotations meets a user-defined criterion (for which the default tolerance is 0.1%). By default, the MAKELIST assumes that the historical natural disturbance regime is stand-replacing fire, and it therefore grows stands for X years for the particular disturbance period for the ecoregion.

4.1.5 Biomass Carbon Modeling

Total biomass flows for each analysis unit were calculated using equations embedded in the CBM-CFS3 and output by representative carbon curves and tracked by carbon pool (see Table 2 below – extracted

⁶ All Woodstock model runs were completed by Ecora (<https://ecora.ca/>). Ecora has been providing modeling support to Island Timberlands since 2009 and for Mosaic since 2019.

from 2019 CBM-CFS3 users manual). The model simulates detailed forest growth and development over time and links this forest development to detailed biomass accumulation and decay functions to track carbon biomass by pool through time. The CBM converts the merchantable volume per ha reported by the growth curves (i.e., yield tables) to tonnes of Carbon (tC) through species-specific allometric equations⁷ (used as Biomass Expansion and Conversion Factors, without any additional value of wood density). All model outputs are in tonnes of Carbon (tC). Effectively CBM modelling manages the carbon pools addressed in VM0012 Equations 1 through to 17b.

The CBM-CFS3 then simulates and tracks the fate of carbon in all applicable carbon pools over time by polygon, including for Wood Products pool after any scheduled event. Carbon calculations can then be summarized for the project and baseline scenarios for each project year across the project area.

Baseline emissions are calculated by applying a Baseline 'disturbances' to each AU, and then modeling the baseline activities and the related carbon flows using CBM-CFS3. The methods described are equivalent to the equations and processes outlined in VM0012.

Data from the CBM-CFS3 output 'Delta Ecosystem Reports' and Woodstock Reports were exported into excel spreadsheets for further analysis consistent with the VM0012 methodology. The reports consist of tables that contain the applicable carbon pools and include reference equations as presented in the methodology. As a result of the proponent's Timber Supply Analysis (completed via Woodstock Runs (WS)) input data is within 5-year periods, which is then interpolated evenly into 1-year increments. Modelling covers all analysis units in both the project and baseline scenarios.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

Table 15: CBM Carbon Pool allocation as detailed with Kurz et al., 2009 (Table 2)

⁷ Boudewyn, P.A.; Song, X.; Magnussen, S.; Gillis, M.D. 2007. Model-based, volume-to-biomass conversion for forested and vegetated land in Canada. Nat. Resourc. Can., Can. For. Serv., Pac.For Cent., Victoria, BC. Inf. Rep. BC-X-411.

Table 2 – Correspondence between pools in the Carbon Budget Model of the Canadian Forest Sector 3—version 1.1 (CBM-CFS3) and recommended pools by the Intergovernmental Panel on Climate Change Good Practice Guidance (GPG) (IPCC, 2003). SW = softwood, HW = hardwood, DOM = dead organic matter.

CBM-CFS3 pool	Description	GPG pool
Merchantable + bark (SW or HW)	Live stemwood of merchantable size ^a plus bark	Aboveground biomass
Other wood + bark (SW or HW)	Live branches, stumps and small trees including bark	Aboveground biomass
Foliage (SW or HW)	Live foliage	Aboveground biomass
Fine roots (SW or HW)	Live roots, approximately <5 mm diameter	Belowground biomass
Coarse roots (SW or HW)	Live roots, approximately ≥5 mm diameter	Belowground biomass
Snag stems DOM (SW or HW)	Dead standing stemwood of merchantable size including bark	Dead wood
Snag branches DOM (SW or HW)	Dead branches, stumps and small trees including bark	Dead wood
Medium DOM	Coarse woody debris on the ground	Dead wood
Aboveground fast DOM	Fine and small woody debris plus dead coarse roots in the forest floor, approximately ≥5 and <75 mm diameter	Litter
Aboveground very fast DOM	The L horizon ^b comprised of foliar litter plus dead fine roots, approximately <5 mm diameter	Litter
Aboveground slow DOM	F, H and O horizons ^b	Litter
Belowground fast DOM	Dead coarse roots in the mineral soil, approximately ≥5 diameter	Dead wood
Belowground very fast DOM	Dead fine roots in the mineral soil, approximately <5 mm diameter	Soil organic matter
Belowground slow DOM	Humified organic matter in the mineral soil	Soil organic matter

^a Definition of merchantable size dimensions are model parameters, see Table 3.

^b Soil Classification Working Group (1998).

4.1.6 Calculating Baseline Scenario Live Biomass Gain

For the Historic Baseline Scenario (as described in Section 3.4), a set of historic baseline activities (disturbances) was based on harvest details within the Timber Supply Analysis utilizing Net Present Value (NPV) principles for estate management. The annual harvest volume has been determined by forward looking harvest volumes and are driven by site productivity and market demand. All baseline management activities are assumed to occur/ begin at year 1 (2018).

Live biomass gain ($\Delta C_{BSL,G,t}$, Eqn 4,5a-b) is calculated by CBM-CFS3 based on the project area and stratifications into analysis units. Regionally specific forest dynamics (BC Admin & Pacific Maritime), and the related carbon curves discussed above, are tracked, and reported by carbon pool (e.g. Aboveground Live, Belowground Live), and reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009).

Data / Parameter	$\Delta C_{BSL,G,t}$
Data unit	t C yr ⁻¹
Description	Eqn 4, 5a-b. Live biomass gain in year, t, polygon i.
Source of data	CBM-CFS3 model runs
Value applied:	Eq 4. $\Delta C_{BSL,G,t} = \sum (A_{BSL,i} \bullet G_{BSL,i,t}) \bullet CF$, where;

	$A_{BSL,i}$ = area (ha) of forest land in polygon, i - values generated based on Project Proponent TSA data. $G_{BSL,i,t}$ = annual increment rate in tree biomass ($t\ d.m.\ ha^{-1}\ yr^{-1}$), in polygon, i, - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model) CF = carbon fraction of dry matter $t\ C\ t^{-1}\ d.m.$ (IPCC default value = 0.5) Eq 5a. $G_{BSL,i,t} = G_{BSL,AG,i,t} + G_{BSL,BG,i,t}$, where; $G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above- and belowground biomass increment rates ($t\ d.m.\ ha^{-1}\ yr^{-1}$), - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model) Eq 5b. $G_{BSL,BG,i,t} = G_{BSL,AG,i,t} \bullet R_i$, where; R_i = Root to shoot ratio - based on regionally specific forest dynamics (embedded within the CBM-CFS3 model)
Justification of choice of data or description of measurement methods and procedures applied	Required by VM0012 methodology.
Purpose of Data	Required for baseline calculations and generating Delta Ecosystem Reports.
Comments	Equations are embedded within the CBM-CFS3 model. These values cannot be altered by the user. The only alteration to the model that could affect parameters described above would be to alter the Ecological Boundary⁸ (i.e., the default Spatial Unit) of the model. All CBM-CFS3 runs completed for the BigCoast Initiative were completed utilizing parameters consistent with the Pacific Maritime Spatial Unit.

4.1.7 Calculating Baseline Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{BSL,L,t}$, Eqn 6, 7, 8, 9) is calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dynamics, including natural tree mortality, harvesting scenario felling/ removals, blowdown, and any other biomass loss. Generally, mortality related live biomass is shifted into dead biomass pools by CBM-CFS3 (Aboveground

⁸ Terrestrial Ecozones of Canada, as defined at <http://www.ecozones.ca/english/zone/index.html>

Standing Dead (snags), Aboveground Downed and Dead Wood (DOM), Belowground DOM), which are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009).

Data / Parameter	$\Delta C_{BSL,L,t}$
Data unit	t C yr ⁻¹
Description	Eq 6, 7, 8, 9. Live biomass loss in year, t, polygon i.
Source of data	CBM-CFS3 model runs
Value applied:	Eq. 6. $\Delta C_{BSL,L,t} = \Sigma(LBL_{BSL,NATURAL,i,t} + LBL_{BSL,FELLINGS,i,t} + LBL_{BSL,OTHER,i,t}) \bullet CF$, where; $LBL_{BSL,NATURAL,i,t}$ = annual loss of live tree biomass due to natural mortality in polygon, i; t d.m. yr⁻¹ $LBL_{BSL,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, i; t d.m. yr⁻¹ $LBL_{BSL,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, i; t d.m. yr⁻¹ CF = carbon fraction of dry matter; t C t⁻¹ d.m. (IPCC default value = 0.5). Eq. 7. $LBL_{BSL,NATURAL,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,NATURAL,i,t}$, where; $A_{BSL,i}$ = area (ha) of forest land in polygon, i – <i>values generated based on Project Proponent TSA data.</i> $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t – <i>values generated based on regionally specific forest dynamics within CBM-CFS3.</i> $LB_{BSL,i,t}$ is calculated for year, t, beginning with biomass estimates in year t=1 (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5a. $f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; $0 < f_{BSL,NATURAL,i,t} < 1$), year, t. - <i>based on regionally specific forest dynamics (embedded within the CBM-CFS3 model), where;</i> Eq. 8. $LBL_{BSL,FELLINGS,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,HARVEST,i,t}$, where; $A_{BSL,i}$ = area (ha) of forest land in polygon, i – <i>values generated based on Project Proponent TSA data</i> $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t (see equation 7 for its calculation).

	$f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 < f_{BSL,HARVEST,i,t} < 1$), in year, t. <i>Data for this variable is obtained through Woodstock modelling</i>. Incidental loss ($LBL_{BSL,OTHER,i,t}$; t d.m. yr⁻¹) is the additional live tree biomass removed for road and landing construction in the polygon, i, and is calculated as a proportion of biomass removed by harvesting: Eq. 9. $LBL_{BSL,OTHER,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,DAMAGE,i,t}$, where; $A_{BSL,i}$ = area (ha) of forest land in polygon, i; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, i, year, t (unitless; $0 < f_{BSL,DAMAGE,i,t} < 1$). Values for this variable are based on regionally specific forest dynamics embedded within CBM-CFS3. Note: much of the forest management planning is completed prior to processing in CBM via Woodstock.
Justification of choice of data or description of measurement methods and procedures applied	Required by VM0012 methodology.
Purpose of Data	Required for baseline calculations and generating Delta Ecosystem Reports.
Comments	Equations are embedded within the CBM-CFS3 model. These values cannot be altered by the user. The only alteration to the model that could affect parameters described above would be to alter the Ecological Boundary⁵ (i.e., the Spatial Unit) of the model. All CBM-CFS3 runs completed for the BigCoast Initiative were completed utilizing parameters consistent with the Pacific Maritime Spatial Unit.

4.1.8 Calculating Baseline Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{BSL DOM,t}$, Eqn 10, 11a-b, 12, 13, 14a-b, 15, 16, 17a-d) are calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model track all stand dead wood dynamics, including standing dead, downed dead, and below ground dead organic matter. CBM-CFS3 uses the regionally specific variant data and related parameters to model

and track dead organic matter between carbon pools (Aboveground Dead (i.e. Stem Snags), Belowground Dead, Aboveground Slow DOM (VM0012 calls this Lying Dead Wood)), and temperate related decay within each pool. Additionally, CBM-CFS3 tracks dead organic matter dynamics related to harvesting (slash) or other events when applied. The project uses the default decay factors and dead matter dynamics that are set within the CBM-CFS3 model and specific to the variant dataset. The results of dead organic matter dynamics are reported in Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009). Generally, carbon stocks are transitioned between dead biomass pools, and emitted as they decay.

Data / Parameter	$\Delta C_{BSL,DOM}$
Data unit	t C yr ⁻¹
Description	Eq 10, 11a-b, 12, 13, 14a-b, 15, 16, 17a-d. Annual change in carbon stocks in Dead Organic in year, t, polygon i.
Source of data	CBM-CFS3 model runs
Value applied:	Eq. 10. $\Delta C_{BSL,DOM,t} = \Delta C_{BSL,LDW,t} + \Delta C_{BSL,SNAG,t} + \Delta C_{BSL,DBG,t}$, where; $\Delta C_{BSL,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr⁻¹ $\Delta C_{BSL,SNAG,t}$ = change in snag carbon stock in year, t; t C yr⁻¹ $\Delta C_{BSL,DBG,t}$ = change in dead belowground biomass carbon stock in year, t; t C yr⁻¹ Eq. 11a. $\Delta C_{BSL,LDW,t} = \sum (LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t}) \bullet CF$ Eq. 11b. $LDW_{BSL,i,t+1} = LDW_{BSL,i,t} + (LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t})$ where; $LDW_{BSL,i,t}$ = The total mass of lying dead wood accumulated in polygon i, at time, t (t d.m.). $LDW_{BSL,IN,i,t}$ = annual increase in LDW biomass for polygon i, year, t (t d.m yr⁻¹). $LDW_{BSL,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon i, year, t, (t d.m yr⁻¹) $LDW_{BSL,IN,i,t}$ and $LDW_{BSL,OUT,i,t}$ are summed across polygons. CF = carbon fraction of dry matter - (IPCC default value = 0.5) Eq. 12. $LDW_{BSL,IN,i,t} = (LBL_{BSL,NATURAL,i,t} - LBL_{BSL,NATURAL,i,t} \bullet R_i) \bullet f_{BSL,BLOWDOWN,i,t} + ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet f_{BSL,BRANCH,i,t} +$

$$((\text{LBL}_{\text{BSL},\text{FELLINGS},i,t} - \text{LBL}_{\text{BSL},\text{FELLINGS},i,t} \bullet R_i) + (\text{LBL}_{\text{BSL},\text{OTHER},i,t} - \text{LBL}_{\text{BSL},\text{OTHER},i,t} \bullet R_i)) \bullet (1 - f_{\text{BSL},\text{BRANCH},i,t}) \bullet f_{\text{BSL},\text{BUCKINGLOSS},i,t} + \text{SNAG}_{\text{BSL},i,t} \bullet f_{\text{BSL},\text{SNAGFALLDOWN},i,t}, \text{ where};$$

$\text{LBL}_{\text{BSL},\text{NATURAL},i,t}$, $\text{LBL}_{\text{BSL},\text{FELLINGS},i,t}$, and $\text{LBL}_{\text{BSL},\text{OTHER},i,t}$ are as calculated in equations 7, 8, and 9, respectively.

R_i is the root:shoot ratio in polygon, i (see equation 5b).

$f_{\text{BSL},\text{BLOWDOWN},i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, i , year, t (unitless; $0 < f_{\text{BSL},\text{BLOWDOWN},i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3*.

$f_{\text{BSL},\text{BRANCH},i,t}$ = the annual proportion of aboveground tree biomass comprised of branches > 5 cm diameter in polygon, i (unitless; $0 < f_{\text{BSL},\text{BRANCH},i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3*.

$f_{\text{BSL},\text{BUCKINGLOSS},i,t}$ = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i (unitless; $0 < f_{\text{BSL},\text{BUCKINGLOSS},i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3*

$\text{SNAG}_{\text{BSL},i,t}$ = the total mass of the snag pool in polygon, i , year, t (see equation 14b).

$f_{\text{BSL},\text{SNAGFALLDOWN},i,t}$ = the annual proportion of snag biomass in polygon, i , year, t , that falls over and thus is transferred to the LDW pool (unitless; $0 < f_{\text{BSL},\text{SNAGFALLDOWN},i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3*

Eq. 13. $\text{LDW}_{\text{BSL},\text{OUT},i,t} = \text{LDW}_{\text{BSL},i,t} \bullet f_{\text{BSL},\text{LDWDECAY},i,t}$, where;

$\text{LDW}_{\text{BSL},i,t}$ = the total amount of lying deadwood mass in polygon i , year, t (see equation 11b).

$f_{\text{BSL},\text{LDWDECAY},i,t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon i , year, t (unitless; $0 < f_{\text{BSL},\text{LDWDECAY},i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3*

Eq. 14a. $\Delta \text{C}_{\text{BSL},\text{SNAG},t} = \Sigma(\text{SNAG}_{\text{BSL},\text{IN},i,t} - \text{SNAG}_{\text{BSL},\text{OUT},i,t}) \bullet \text{CF}$

Eq. 14b. $\text{SNAG}_{\text{BSL},i,t+1} = \text{SNAG}_{\text{BSL},i,t} + (\text{SNAG}_{\text{BSL},\text{IN},i,t} - \text{SNAG}_{\text{BSL},\text{OUT},i,t})$, where;

$\text{SNAG}_{\text{BSL},i,t}$ = The total mass of snags accumulated in polygon i , at time t (t d.m.).

$SNAG_{BSL,IN,i,t}$ = annual gain in snag biomass for polygon i, year, t (t d.m yr⁻¹).

$SNAG_{BSL,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m yr⁻¹)

CF = carbon fraction of dry matter (*IPCC default value = 0.5*)

Eq. 15. $SNAG_{BSL,IN,i,t} = (LBL_{BSL,NATURAL,i,t} - LBL_{BSL,NATURAL,i,t} \bullet R_i) \bullet (1 - f_{BSL,BLOWDOWN,i,t})$, where;

$LBL_{BSL,NATURAL,i,t}$ is as calculated in equation 7

$1 - f_{BSL,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, i, year, t, but remains as standing dead organic matter (i.e., snags) (unitless; $0 < f_{BSL,BLOWDOWN,i,t} < 1$) - *values generated based on regionally specific forest dynamics within CBM-CFS3.*

Eq. 17a. $\Delta C_{BSL,DBG,t} = \Sigma(DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \bullet CF$

Eq. 17b. $DBG_{BSL,i,t+1} = DBG_{BSL,i,t} + (DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t})$, where;

$DGB_{BSL,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon i, at time, t (t d.m.).

$DBG_{BSL,IN,i,t}$ = annual gain in dead belowground biomass for polygon i, year, t (t d.m yr⁻¹). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities.

$DBG_{BSL,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m yr⁻¹)

CF = carbon fraction of dry matter (*IPCC default value = 0.5*)

Eq. 17c. $DBG_{BSL,IN,i,t} = [(A_{BSL,i} \bullet LB_{BSL,i,t} \bullet R_i) \bullet (f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t})]$, where;

$A_{BSL,i}$ = area (ha) of forest land in polygon, i; - *values generated based on Project Proponent TSA data*

$LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t. $LB_{BSL,i,t}$ is calculated for year, t, beginning with biomass estimates in year t=1 (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5 a, b. This value is then multiplied by $A_{BSL,i}$, the area (ha) of forest land in polygon, i.

R_i is the root:shoot ratio in polygon, i (see equation 5b).

	$f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; $0 < f_{NATURALi} < 1$), year, t (see equation 7), $f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 < f_{HARVESTi} < 1$), year, t (see equation 8), $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed or road and landing construction in polygon, i (unitless; $0 < f_{DAMAGE,i,t} < 1$), year, t (see equation 9) Eq. 17d. $DBG_{BSL,OUT,i,t} = DBG_{BSL,i,t} \bullet f_{BSL,dgbDECAY,i,t}$, where; $DBG_{BSL,i,t}$ = the total quantity of dead belowground in polygon i, year, t (see equation 17b). $f_{BSL,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon i, year, t (unitless; $0 < f_{BSL,lwDECAY,i,t} < 1$) - <i>values generated based on regionally specific forest dynamics within CBM-CFS3</i>
Justification of choice of data or description of measurement methods and procedures applied	Required by VM0012 methodology.
Purpose of Data	Required for baseline calculations and generating Delta Ecosystem Reports.
Comments	Equations are embedded within the CBM-CFS3 model. These values cannot be altered by the user. The only alteration to the model that could affect parameters described above would be to alter the Ecological Boundary⁵ (i.e., the Spatial Unit) of the model. All CBM-CFS3 runs completed for the BigCoast Initiative were completed utilizing parameters consistent with the Pacific Maritime Spatial Unit.

4.1.9 Harvested Wood Product Modeling

Step 1 utilizes Woodstock (Remsoft) output reports that forecast species, product groups (e.g., CNS - Chip 'n Saw) and related harvest volumes (m³) for each planning period. These are then converted to

Merchantable Carbon/ Wood Products pool using species specific wood densities⁹ in Tonnes of Carbon (tC) and satisfies the requirements of Step 1 of the methodology.

The following product groups from Woodstock are assigned to the following product type (k) categories:

Pulpwood: PLP - Pulp
Saw Log: CNS – Chip n’ Saw, GNG – Gang, MER – Merch Log, Std - Standard, SHN – Shake/
Shingle & PEL - Peeler

For the purposes of Step 2 (Carbon contained in harvested timber after milling, $C_{BSL,MILL,h}$; tC, Equation 21) Forest Product Conversion Factors for the UNECE Region published by the United Nations Economic Commission for Europe (UNECE/FAO. 2010) ($f_{RND,k}$, $r_{RND,k}$) was used to determine the total carbon in harvested timber that will enter the wood products pool by product type accounting for mill efficiencies and estimated product disposition percentages. The gross quantity of carbon contained in harvested timber for each of the four product types (k) described in Step 1 must be decremented (process of decreasing or becoming gradually less) to account for losses during processing. This loss is calculated within *Mosaic - BSL HWP (Jun '22)* excel spread sheet specifically tab ‘Step 2 (Mill)’.

VM0012 requires calculation of 3 harvested wood pools:

1. Short-lived wood products (SLF), which are defined as wood products in use for <3 years; and assumed to be emitted immediately.
2. Medium-lived wood products (MLF), which are defined as wood products in use for 3-100 years; and assumed to be emitted on a 20-year straight line decay curve.
3. Long-lived wood products (LLF), which are wood products in use for 100+ years.

Note: products in landfill are assumed to be “in use” and treated as per these 3 HWP pools.

For the final step 3 (Carbon storage in medium-term and long-term wood products, $C_{BSL,STORHWP,t}$, Equation 23) the total carbon lost in short-lived products (SLF – $P_{BSL,SLF,k}$, Equation 22a) and stored in medium-term (MLF – $P_{BSL,MLF,k}$, Equation 22c) and long-term (LLF – $P_{BSL,LLF,k}$, Equation 22b) products used Smith, et al (2006) reference tables and factors to calculate the result is a fraction of the Wood Products pool being emitted or stored annually based on each ‘In-Use’ category based on product, decay and storage factors. These values are summed for every year (t) utilizing a cohort approach.

The annual change in carbon storage in harvested wood products ($\Delta C_{BSL,STORHWP,t}$; t C yr⁻¹, Equation 19) is calculated from the annual results of Equation 23.

These HWP modelling calculations are applied equally to any timber harvesting in either the Baseline or Project Scenario.

Data / Parameter	$\Delta C_{BSL,STORHWP,t}$
Data unit	t C yr ⁻¹
Description	Eq 18, 19, 20, 21, 22a-c, 23 Carbon storage in harvested wood products

⁹ Refer to Appendix 5 – VM0012 Equations and default values used – Species specific wood densities

Source of data	CBM-CFS3 model runs
Value applied:	Eq. 19. $\Delta C_{BSL,STORHWP,t} = (C_{BSL,STORHWP,t2} - C_{BSL,STORHWP,t1}) / T$, where; $C_{BSL,STORHWP,t2}$ = carbon storage in harvested wood products at $t=2$; t C $C_{BSL,STORHWP,t1}$ = carbon storage in harvested wood products at $t=1$; t C T = number of years between monitoring $t1$ and $t2$ t : 1,2,3...t years elapsed since the project start date Eq. 20. $C_{BSL,TIMBER,h} = \Sigma[(L_{BSL,FELLINGS,i,h} - L_{BSL,FELLINGS,i,h} \bullet R_i + L_{BSL,OTHER,i,h} - L_{BSL,OTHER,i,h} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,h}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,h})] \bullet CF$, where; $C_{BSL,TIMBER,h}$ = carbon contained in timber harvested in period h (summed for all harvested polygons, i); t $L_{BSL,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, i; t d.m. (equation 8) $L_{BSL,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. (equation 9) R_i is the root:shoot ratio in polygon, i (see equation 5b) $1 - f_{BSL,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon i (unitless; $0 < f_{BRANCH,i,t} < 1$) (see equation 12) $1 - f_{BSL,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, i (unitless; $0 < f_{BUCKINGLOSS,i,t} < 1$) (equation 12) h = harvest period ; yr Eq. 21. $C_{BSL,MILL,h,k} = (C_{BSL,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k})$, where; $C_{BSL,MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type k; t C $C_{BSL,TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type k; t C – <i>values generated from CBM-CFS3 outputs (total Softwood Merch, Softwood “other”, Hardwood Merch, Hardwood “other”).</i> k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood); - <i>proportions determined by project proponent via Woodstock Modelling</i>

$f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type k. – to account for losses including bark and milling waste, forest product conversion factors were extracted from UNECE DP49, Table 3.4 for Canada (UNECE/FAO. 2010).

$r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type k. - to account for losses including bark and milling waste, forest product conversion factors were extracted from UNECE DP49, Table 3.4 for Canada (UNECE/FAO. 2010).

- Values for forest product conversion factors for coniferous sawnwood in Canada:
 - Sawdust: 5%
 - Shavings: 4%
 - Chips/slabs: 38%
 - Sawdust: 8%

Eq. 22a. $P_{BSL,SLF,k} = 1 - P_{3-year}$

- P-SLF Values used:
 - Softwood Sawlog – 0.36
 - Hardwood Sawlog – 0.6
 - Softwood Pulp – 0.669
 - Hardwood Pulp – 0.6

Eq. 22b. $P_{BSL,LLF,k} = P_{100-year}$

- P-LLF Values used:
 - Softwood Sawlog – 0.13
 - Hardwood Sawlog – 0.03
 - Softwood Pulp – 0
 - Hardwood Pulp – 0.03

Eq. 22c. $P_{BSL,MLF,k} = P_{3-year} - P_{100-year}$

- P-MLF Values used:
 - Softwood Sawlog – 0.23
 - Hardwood Sawlog – 0.57
 - Softwood Pulp – 0.699
 - Hardwood Pulp – 0.57

	Eq. 23. $C_{BSL,STORHWP,t} = \sum \sum ((C_{BSL,MILL,h,k} \bullet P_{LLF,k}) + [(C_{BSL,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20-h) / 20)])$ $C_{BSL,STORHWP,t}$ = carbon stored in harvested wood products in year t summed for all product types k and then over all harvest periods h; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood); proportions determined via Woodstock Modelling h = year of harvest (the term (20-h) should not be allowed to drop below 0)
Justification of choice of data or description of measurement methods and procedures applied	Required by VM0012 methodology.
Purpose of Data	Required for baseline calculations and generating Harvested Wood Products deductions.
Comments	Proprietary excel spreadsheet used to complete calculations.

4.1.10 Fossil fuel emissions associated with logging, transport, and manufacture

BigCoast has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions ($\Delta C_{BSL,EMITFOSSIL,t}$, Eqn. 24,25,26,27) from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups).

Default values in VM0012 Table 4 have been used. All calculations in support of this is within: Emissions_BSL_Estimate (Aug '22) spreadsheet. See Appendix

Woodstock (Remsoft) output reports that forecast species, product groups (e.g., CNS - Chip 'n Saw) and related harvest volumes (m^3) for each planning period were used for the following calculations. Results are then converted to Merchantable Carbon pool using species specific wood densities along with a Carbon Fraction (CF = 0.5) providing Tonnes of Carbon (tC) harvested for each planning period. This is equivalent to $C_{BSL,TIMBER,h}$ as represented by Eq. 20 being the carbon contained in timber harvested in period h.

The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as:

$$C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t} \text{ (Eq. 24)}$$

Each of the carbon components are calculated as noted below:

Equation 25:

$C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr⁻¹).

$$C_{BSL,EMITHARVEST,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet CHARVEST$$

All timber in the BigCoast project is harvest via clearcutting and the default value for $CHARVEST$ is used.

Equation 26:

$C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr⁻¹).

$$C_{BSL,EMITTRANSPORT,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet \Sigma(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet C_{TRANSPORTk})$$

$f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; 0 < 1). All timber in the BigCoast project is transported by truck.

$d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); The Woodstock outputs contain information on the 'basin' (watershed) timber was harvested in. Haul distance from the cutblock to either a Mosaic Dryland Sort (DLS), chipper sites or direct delivery customers. The boundaries of this emission calculation are from cutblocks (as defined by basins) to log sorts or direct delivery customers on Vancouver Island and do not include towing to Vancouver or any other type of log transportation (trans-national log export). This is conservative in nature.

The transport distance is calculated using an average haul distance (km) for each Sub-basin to the closest or relevant log dump, sort, or mill within the project area. The average speed is travelled by logging trucks is 60 km/hr. A weighted average by species and basin is used.

$C_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k. The table 4 for default values are used.

Equation 27

$C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr⁻¹).

$$C_{BSL,EMITMANUFACTURE,t} = \Sigma[C_{BSL,TIMBER,h}] \bullet \Sigma(f_{BSL,PRODUCTk} \bullet C_{MANUFACTUREk})$$

$C_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k;

The following product groups from Woodstock are assigned to the following product type (k) categories:

1. Pulpwood (Chemical): PLP - pulp
2. Saw Log: CNS – Chip n' Saw, GNG – Gang, MER – Merch Log, Std - Standard, SHN – Shake/Shingle
3. Veneer/ plywood: PEL - Peeler

For each product type (k) the table 4 for default values are used.

BigCoast has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups).

Default values in VM0012 Table 4 have been used for Equations 24 – 27. All calculations in support of this are within the *Emissions_BSL_Estimate* (Jun '22) spreadsheet.

Data / Parameter	$\Delta C_{BSL,EMITFOSSIL,t}$
Data unit	t C yr ⁻¹
Description	Eq 24, 25, 26, 27 Annual change in fossil fuel emissions from harvesting and processing of wood products
Source of data	Woodstock Modelling
Value applied:	Eq. 24. $C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t}$, where; $C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr⁻¹) $C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr⁻¹) $C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr⁻¹) Eq. 25. $C_{BSL,EMITTRANSPORT,t} = \sum[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet \sum(f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet C_{TRANSPORTk})$, where; $f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; $0 < f_{BSL,TRANSPORTk} < 1$). $d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); - values determined by project proponent (internally tracked during regular process) $C_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k - VM0012 Table 4 default value for Truck ($7.0 \cdot 10^{-5}$) utilized Eq. 27. $C_{BSL,EMITMANUFACTURE,t} = \sum[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet Ri + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet Ri) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet \sum(f_{BSL,PRODUCTk} \bullet C_{MANUFACTUREk}) \bullet CF$, where; $C_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k; - VM0012 Table 4 default value for Sawnwood (0.04), chemical pulp (0.13) and veneer (0.06) were utilized All other terms are as defined in equation 19.
Justification of choice of data or description of	Required by VM0012 methodology.

measurement methods and procedures applied	
Purpose of Data	Required for baseline calculations and generating Fossil Fuel Emissions calculations.
Comments	Proprietary excel spreadsheet used to complete calculations.

4.1.11 Calculating Baseline Stock Change

In regard to model outputs the Stock Change resultant 'Delta Total Ecosystem' ($\Delta tC \text{ yr}^{-1}$) represents Total change in Ecosystem carbon stocks as required in Equation 1: annual change in living tree biomass ($\Delta C_{BSL, LB, t}$) (Refer to Sections 4.1.6 & 4.1.7) and annual change in dead organic matter ($\Delta C_{BSL, DOM, t}$) (Refer to Section 4.1.8). CBM also provides the required output for the annual change in carbon stocks associated with harvested wood products ($\Delta C_{BSL, HWP, t}$) (Refer to Section 4.1.9).

The Stock Changes category of output variables contains information about changes in carbon stocks, reported in tonnes of carbon for each year, for the area selected by the user. A positive value (+) for annual change in carbon stock indicates a net gain in carbon stocks, a negative value (-) indicates a net loss, and a zero value indicates neither a gain nor a loss. For analyses of Total Delta Ecosystem, annual values greater than zero indicate that the ecosystem is functioning as a carbon sink, annual values below zero indicate that it is functioning as a carbon source, and an annual value of exactly zero indicates that the ecosystem is carbon-neutral (i.e., neither a source nor a sink). Refer to the GHG Estimate calculation spreadsheet provided.

4.2 Project Emissions

Project emissions and carbon flows are calculated in the same manner as the baseline emissions discussed in the Section 4.1. Calculations use the same forest inventory data, analysis units, polygons, modeling tools, and equations under the Project Scenario activities. Project and Baseline Scenarios and polygon versions of each are tracked and calculated simultaneously in the supporting spreadsheets using the same parameters, outputs, and analysis under each scenario. In the project scenario, carbon flows are modeled using project activities (full harvest deferral) throughout the term of the project.

Project activities affecting GHG emissions were carried out during the initial project period (2018-2021) however, no project scenario activities were projected on an *ex-ante* basis. Future years may include various project forest management activities that affect *ex-post* carbon stocks which will be monitored and reported on in future verifications (e.g., salvage due to significant fire or forest health loss). Project activities will be based on actual monitoring results (see Section 5) and any resulting emissions netted against emission reductions.

The methods described are equivalent to the equations and processes outlined in VM0012.

4.2.1 Development of Project Scenarios and Assumptions

The project scenario is modeled as conservation, LTPF, with a focus on maintaining forest health if required. No other activities affecting carbon stocks are scheduled on an *ex-ante* basis, aside from normal forest growth and development as modeled by CBM-CFS3.

4.2.2 Determination of Actual Onsite Carbon Stocks

Ex-ante Project Scenario carbon stocks are calculated in the same manner as the baseline emissions discussed in Section 4.1. Calculations are completed using the same forest inventory data, analysis units and polygons, and modeling tools under the Project Scenario activities.

4.2.3 Ex-Post Calculations of Carbon Stocks

Ex-post carbon stocks in the Project Scenario are determined at each verification following the steps outlined in VM0012. Each monitoring report will detail the data and calculations for *ex-post* onsite carbon stocks at the time of verification. However, as the project start date (2018) is prior to validation, the initial period (2018-2021) *ex-ante* carbon stocks are also the *ex-post* carbon stocks.

Project carbon stocks from 2022 forward are on an estimated *ex-ante* basis.

The *ex-post* carbon calculations are made for the Baseline and Project Scenarios as outlined in Section 6.2.7 and 6.3.6 respectively, with updates to carbon inventory, spatial data, project instance, and other data for each verification period.

For the 2018-2021 period, the carbon stocks are calculated from the latest set of inventory and spatial data, which inherently include *ex-post* monitoring for that period.

43 permanent carbon plots were established in 2021-2022 (See Section 5.2.3) with representation across all Analysis Units to monitor inventory and model accuracy. Additional permanent sample plots may be installed to improve inventory accuracy, spatial coverage, and Analysis Unit representation as deemed necessary. The initial *ex-post* carbon stock spatial forest inventory and analysis is using the latest available ortho-imagery, LiDAR data, and other GIS datasets, in conjunction with site visits from Project Proponent staff to confirm the status of project activities and disturbances. The modeling related to these data has been applied across both the Project Scenario and Baseline Scenarios. The uncertainty calculations in the first verification period are up to date for the latest inventory plot data and modeling results.

In future verification periods, the project will calculate *ex-post* carbon stocks by addressing any spatial changes to the project area, then updating the forest inventory and carbon modeling results, including for any other monitoring results or updates.

Additional carbon plots may be installed to improve inventory accuracy, spatial coverage, and/or Analysis Unit representation. *Ex-post* carbon calculations will be undertaken using the latest imagery, LiDAR, and GIS datasets for the project area. Project activities and disturbances will be monitored by remote sensing or field visits and updated into the forest inventory prior to the following verification period. All modeling and inventory updates and calibrations will be applied equally across the Project and Baseline Scenarios. The uncertainty factor, leakage assessments, and non-permanence risk factors will be recalculated using the latest forest inventory, plot data, and project information.

4.3 Leakage

4.3.1 Activity Shifting Leakage [*]

VM0012 does not provide specific equations nor methods for calculating net emissions related to activity shifting leakage. VCS requires that “IFM project developers must demonstrate that there is no leakage within their operations – i.e., on other lands they manage/ operate outside the bounds of the VCS carbon project”. The methodology requires monitoring and reporting on evidence demonstrating no activity shifting is occurring in order to demonstrate compliance with VCS.

STEP 1 - the locations and descriptions of all forestlands within the project over which the Project Proponent has ownership is available. The entities own approximately 450,000 gross hectares of forest lands adjacent to the project instance. Of this approximately 420,000 are within the Timber Harvesting Land Base (THLB) and potentially subject to Activity Shifting.

STEP 2 –demonstrate that there is no activity shifting leakage to areas that are outside the project instance and that have not materially changed as a result of the project activity (e.g., harvest rates have not been increased).

Due to the project lands being managed under private forest land requirements, harvest levels can shift from year to year based on market demand, weather, human and capital resources, corporate strategic/tactical decisions, political/ regulatory changes, etc. In order to determine if harvests occurring during the project lifetime would be considered activity shifting, a baseline (historic) harvest variance needed to be determined.

To determine a baseline variance, data related to modelled and actual historical harvest volumes from both Island Timberlands and TimberWest land bases was used. For purposes of this analysis, outputs from the separate reporting mechanisms have been combined to reflect the Project Proponents landbase, however, it should be noted that the lands were managed separately during this period.

Throughout the time period from 2013 – 2017, there were two instances (2013 and 2014) where harvest totals were reported as above the modelled harvest total (102% and 103% respectively). In these given years, harvest conditions were optimal and best reflect a best case scenario. In order to allow for future business processes to operate with the intentions of optimizing profits, the following method was used to produce a baseline, best case scenario benchmark for the purposes of assessing future risk of activity shifting leakage.

To complete the analysis, the total modelled harvest volumes for 2013 through 2017 were compiled and individually multiplied by 1.02, thus representing a best case scenario for 5 year baseline period. The average was then calculated for these volumes. The resulting average will be used as a benchmark indicator for future harvest rates. Figure 2 below demonstrates the assessment completed.

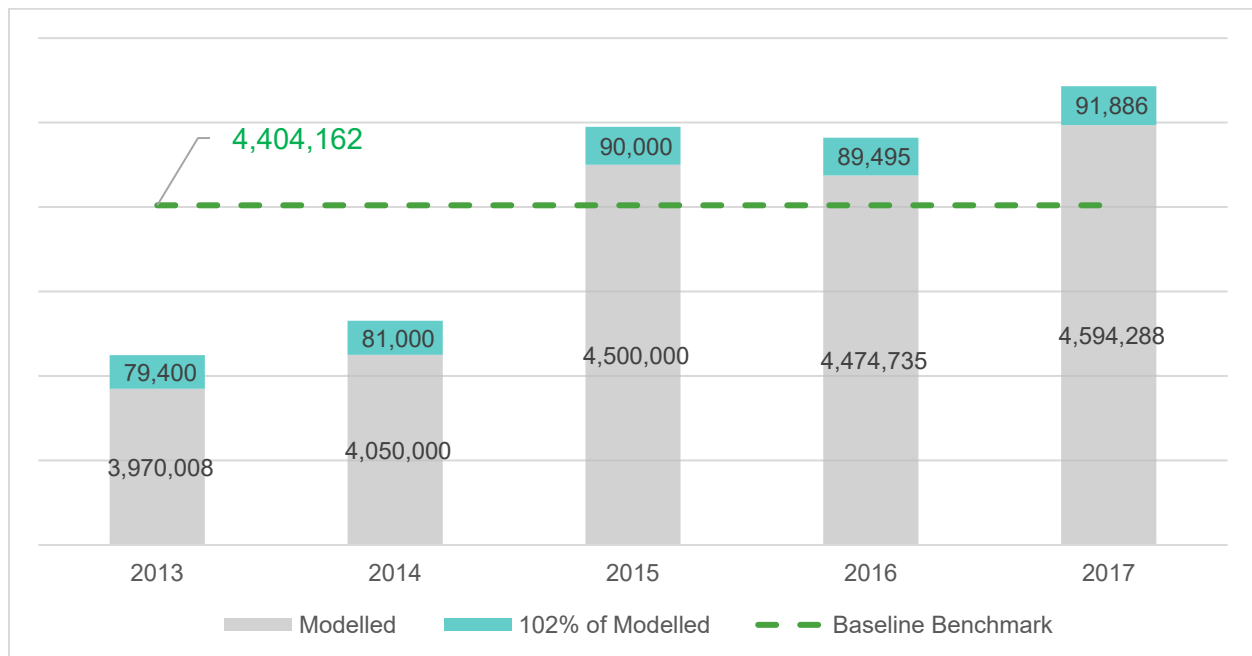


Figure 2. Baseline harvest assessment

Utilizing the determined benchmark, future harvest levels (actual harvest and deferred harvest via project implementation) that fall outside (i.e., above) the benchmark determined from the 2013 – 2017 could be considered activity shifting leakage.

In the future, the baseline benchmark volume may change due to modifications in corporate strategic modelling conditions for the TLHB (e.g., updates in inventory, changes in merchantability specifications, changes in costs/sales prices, etc.)

4.3.2 Market Leakage

The VM0012 LtPF methodology provides three options for market leakage. The BigCoast project utilizes 'Option 1' and the most current VCS market leakage discount method. Specifically, VCS Module VMD0033 - Estimation of Emissions from Market Leakage is used. The VCS module utilizes a stepwise procedure as outlined below.

Step 1: Identification of commodities and services

Logs harvested in the BigCoast initiative are linked to international markets (log and lumber) and a significant amount of the country's production is traded on international commodities markets. The industry in Canada is highly export-oriented with nearly 70% of production exported. The majority of these exports are to the U.S., China and Japan. Of these three countries, the U.S. imported over 50% of Canada's softwood lumber production¹⁰.

The commodities (as identified in table 16) that may be reduced as part of the project implementation meet the following criteria:

1. Commodity was produced within the project area prior to the project commencement
 - Landowners Island Timberlands LP and TimberWest Forest Corporation have been in operation within coastal British Columbia producing wood products since 2005 and 1997, respectively.
2. The commodity is not produced solely for the producer's use as it was sold to others
 - Mosaic (forest management corporation for Island Timberlands and TimberWest) does not own any manufacturing sites, therefore all fibre produced within Mosaic forestlands is sold to others.
3. The commodity provides more than 5% of the total cash and barter income earned by residents within the project area.
 - This criterion does not apply to the BigCoast as there are no residents that reside directly within the project area.

¹⁰ Canada's softwood lumber industry: <https://www.nrcan.gc.ca/our-natural-resources/forests/industry-and-trade/canadas-softwood-lumber-industry/19601>

- As assessed, the market for logs is almost a 50/50 split between the domestic and export markets. Although the project area is only a proportion of the Project Proponent's landbase, the make up of the project area is representative of the products and market distribution as described above.
- There is no National market for logs as transporting logs by truck interprovincially as it is not cost effective.

Step 2: Barrier Analysis [*]

Forestry is a foundational industry within British Columbia. In 2022 forest-based products were BC's #1 export (28.8% of all exports by value)¹¹, with the Forestry Logging and Support sector directly contributing ~3.0 billion in provincial GDP. Due to the industry being integral to the BC economy, any barriers surround the log market can be considered low (i.e., readily substituted, no significant barriers exist to bringing the product or service into the local market from the regional market). The only Regulatory Barrier is for Cedar and Cypress logs. Table 17 below, identifies and grades all existing barriers within the local, regional, and international markets. Justification for barrier grading is discussed below.

¹¹ https://www.cofi.org/wp-content/uploads/TECHNICAL-REPORT_COFI-2019-FOREST-INDUSTRY-ECONOMIC-IMPACT-STUDY-FINAL.pdf

Table 16. Barrier grades

Market (Logs)	Barrier	Grade
Local (within Vancouver Island)	Distribution (cost of transportation)	Low
Regional (within the Lower Mainland, Coastal and Interior BC)	Distribution (cost of transportation)	Low
National (within Canada)	-	-
International (worldwide)	Regulatory Barrier (cedar/cypress logs only)	Low

4. Local Market Barrier: Distribution (cost of transportation)

Grade: Low

- Costs of distribution are dependent on mode of transportation (truck, boom & barging) and location of destination.
- Ranges in hauling costs are largely dependent on stand age and harvest method, therefore this cost would not significantly increase (>5%) for market participants sourcing from within Vancouver Island. Costs such as these are proprietary.
- These costs, have been determined based on the Project Proponent's forest practices and are used as "baseline" costs for other market participants.

5. Regional Market Barrier: Distribution (cost of transportation)

Grade: Low

- The common mode of transportation in the regional market is via log booms or log barges.
- Both the local and regional markets are interdependent, therefore costs for regional distribution could be considered compounded (i.e., logs are distributed from the woods to the dry land sort (local market distribution costs) and from the log sort onto barges or into log booms and transported regionally (distribution costs)). The barging transportation provided in the coast appraisal manual is \$10.00/m³¹² for Coastal BC (excluding Haida Gwaii) therefore this cost would not significantly increase (>5%) for market participants sourcing from the regional market.
- Costs of distribution within the regional market are dependent on supplier and customer contracts and vary on a customer by customer basis, however, commodity markets are extremely tight/ low margin based on commodity futures. Therefore, costs to the customer for regional distribution would not significantly increase (>5%) regardless of product type.

¹² 2022 BC Cost appraisal manual

6. International Market Barrier: Regulatory (cedar/ cypress log export)

Grade: Low

- In British Columbia within the Coast Area, under the Manufactured Forest Products Regulation (MFPR), any Western red cedar or cypress log must be manufactured into lumber prior to being exported. This prohibits the export of any cedar or cypress log.
- This regulation applies to other species (other than cedar and cypress) within British Columbia, however, effective permitting processes are in place to allow for the export of logs.
- The MFPR relates exclusively to exports from within British Columbia, however, is not applicable to imports. Therefore, this regulation creates a barrier within the international market, however, does not create a barrier between markets (international to regional/ local).

Step 3: Re-assessment of markets

Due to the lack of barriers within, and between all identified markets, the recalculation of markets results in 100% of the log market at the international scale.

Table 17. Re-assessment of markets

Market	Logs* (%)	Market Scale* (m3/yr) – Logs	Barrier Grade	Re-calculation (%)
Local	14.8%	586,500	Low	-
Regional	28.2%	1,113,500	Low	-
National	-	-	-	-
International	57%	2,200,000	Low	100%
Total:	100%	3,900,000		

Step 4: Percentage of market supplied

When comparing the cubic meters of logs impacted by project implementation, to the average cubic meters harvested within coastal BC, the Project Proponent's portion of the log market resulting from the project area represents 1.40%. Note: this valuation is conservative by using volumes of the next applicable market scale (i.e., regional).

Table 18. Percent of market supplied

Market	Logs (%) – Re-calc	Market Scale (m3/yr) – Logs (re-calculated)	% of total market
Local	-	-	-
Regional	-	-	-
National	-	-	-
International	100	245,593	1.40%
Total BC Coast Harvest (average) ¹³ :		17,500,000	

Step 5: Market Significance

Less than 3% of total market in each market (international market) - continue to Step 10.

¹³ https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-industry-economics/economic-state/2020_economic_state_of_the_bc_forest_sector.pdf

Step 10: Market Flexibility

As reported within Ministry of Forests, Lands and Natural Resource Operations and Rural Development's (MFLNORD) 2020 Economic State of British Columbia's Forest Sector report, the top importers of wood products from BC within the international market are the United States (46% share of BC exports), China (28% share of BC exports), and Japan (10% share of BC exports). Combined, BC exports an average of \$12 billion worth of forest products annually. This number, however, often fluctuates with market demand. From 2010 to 2020, the total value of the forest products export market varied from \$9.1 billion in 2010 to a high of \$14.8 billion in 2018 then decreased to \$11.5 billion at the end of 2020. These swings in export values reflect the on-going variability of the log export market.

Due to the forestry sector in BC being robust and spanning the entire province, the industry is able to adapt to market adjustments when necessary. This results in the market undergoing fluctuations and industry utilizing mechanisms such as surplus, substitution, and intensifying capacity. It should be noted that due to stringent regulation (i.e., sustainable harvest levels, harvesting permits, etc.) markets demands causing intensification would not result in the over harvesting of forest lands.

Market Leakage Determination

In conclusion, due to the BigCoast initiative's small market share (<3%) as well as the flexibility of the international market, it can be determined that no market leakage due to the BigCoast initiative is anticipated and therefore a market leakage factor (MLF_y) equal to 0 is utilized.

4.4 Estimated Net GHG Emission Reductions and Removals

Estimated net GHG emission reductions and removals are calculated based on estimated baseline and project emissions, calculated as described in Sections 4.1 and 4.2.

4.4.1 Calculation of Emissions Reductions

Gross carbon emissions reductions (ER_{y,GROSS}; t CO₂e yr⁻¹) created by the BigCoast Initiative were calculated annually as the difference between the baseline and project scenario emission reductions/emissions:

$$ER_{y,GROSS} = (\Delta C_{BSL,t} - \Delta C_{PRJ,t}) \bullet 44/12 \quad (57)$$

Where,

$\Delta C_{BSL,t}$ = total baseline scenario emissions calculated from equation 1 (t C yr⁻¹).

$\Delta C_{PRJ,t}$ = total project scenario emissions calculated from equation 29 (t C yr⁻¹).

44/12 = factor to convert C to CO₂e

The annual net GHG emissions reductions are calculated each year using Equation 58.

$$ER_y = ER_{y,GROSS} - LE_y \quad (58)$$

where:

ER_y = the net GHG emissions reductions and/or removals in year y (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) ($t\ CO_2e\ yr^{-1}$).

$ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios ($t\ CO_2e\ yr^{-1}$).

LE_y = Leakage in year y ($t\ CO_2e\ yr^{-1}$), as calculated in equation 56b below.

$$LE_y = MLF_y \bullet ER_{y,GROSS} \quad (56b)$$

Ex-ante net GHG emissions are calculated below in Table 19.

Table 19: Estimated ex-ante Net GHG Emissions Reductions or Removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
January 1, 2018 - December 31, 2018	-144,512	112,699	-	257,210
January 1, 2019 - December 31, 2019	-169,923	108,302	-	278,225
January 1, 2020 - December 31, 2020	-187,347	108,820	-	296,167
January 1, 2021 - December 31, 2021	-202,166	109,274	-	311,440
January 1, 2022 - December 31, 2022	-349,405	109,599	-	459,004
January 1, 2023 - December 31, 2023	-521,721	109,865	-	631,586
January 1, 2024 - December 31, 2024	-562,832	105,165	-	667,997
January 1, 2025 - December 31, 2025	-593,454	105,558	-	699,012
January 1, 2026 - December 31, 2026	-619,003	105,945	-	724,948
January 1, 2027 - December 31, 2027	-660,888	106,211	-	767,099

January 1, 2028 - December 31, 2028	-450,699	106,446	-	557,145
January 1, 2029 - December 31, 2029	-451,913	100,574	-	552,487
January 1, 2030 - December 31, 2030	-447,868	100,962	-	548,830
January 1, 2031 - December 31, 2031	-443,790	101,383	-	545,174
January 1, 2032 - December 31, 2032	-524,215	101,762	-	625,977
January 1, 2033 - December 31, 2033	-435,661	102,148	-	537,809
January 1, 2034 - December 31, 2034	-437,386	96,316	-	533,702
January 1, 2035 - December 31, 2035	-433,902	96,561	-	530,462
January 1, 2036 - December 31, 2036	-429,851	96,837	-	526,688
January 1, 2037 - December 31, 2037	-389,567	97,141	-	486,707
January 1, 2038 - December 31, 2038	-380,932	97,392	-	478,325
January 1, 2039 - December 31, 2039	-375,169	92,182	-	467,350
January 1, 2040 - December 31, 2040	-365,944	92,360	-	458,304
January 1, 2041 - December 31, 2041	-357,128	92,539	-	449,667
January 1, 2042 - December 31, 2042	-346,951	92,722	-	439,673
January 1, 2043 - December 31, 2043	-340,979	92,852	-	433,831
January 1, 2044 - December 31, 2044	-336,604	87,775	-	424,380

January 1, 2045 - December 31, 2045	-329,165	87,932	-	417,097
January 1, 2046 - December 31, 2046	-322,615	88,090	-	410,706
January 1, 2047 - December 31, 2047	-692,412	88,245	-	780,657
Total	-12,304,002	2,993,658	-	15,297,660

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	Spatial Inventory data ($A_{BSL,i}$, $A_{PRJ,i}$)
Data unit	Hectares (Ha)
Description	Respective areas of baseline and project polygon, i for the project instance.
Source of data	GPS Coordinates, inventory records, spatial data using a Geographic Information System (GIS). Project Proponent GIS spatial inventory data used for inventory and project boundary delineation.
Value applied:	Each polygon has an area.
Justification of choice of data or description of measurement methods and procedures applied	Spatial and tabular inventory data via Land Resource Manager (LRM). It is an enterprise resource planning application for managing assets and activities associated with both land and forests. An ESRI ArcGIS platform is integrated with the LRM to offer geographical information system functionality. All spatial data and its derivatives (areas, perimeters etc.) are derived from this program.
Purpose of Data	Required for baseline and project calculations.
Comments	Includes delineation of project areas and polygons.

Data / Parameter	CF
Data unit	t C t-1 d.m.
Description	Carbon fraction of dry matter.
Source of data	IPCC 2006 default value.
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied	Best available data.

Purpose of Data	Required for baseline and project calculations.
Comments	Embedded in CBM-CFS3

Data / Parameter	BEF
Data unit	Unitless
Description	Biomass expansion factors (BEF) for conversion of productivity metrics to biomass,
Source of data	CBM-CFS3 default values.
Value applied:	CBM-CFS3 calculates the Biomass Expansion Factor as a function of jurisdiction, ecozone and tree species.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 data is widely reviewed and accepted.
Purpose of Data	Calculation of baseline and project emissions.
Comments	

Data / Parameter	R_i
Data unit	Unitless
Description	Root:shoot ratio in polygon, i
Source of data	CBM-CFS3 default values.
Value applied:	CBM-CFS3 variants calculates belowground biomass as a function of tree species and tree size.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 data is widely reviewed and accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	Root allocation can vary by site productivity.

Data / Parameter	$f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 < f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t} < 1$)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3.
Value applied:	Default settings in CBM-CFS3.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for baseline and project calculations.
Comments	

Data / Parameter	$f_{BSL,DAMAGE,i,t}$, $f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{BSL,DAMAGE,i,t}$, $f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of additional biomass removed by for road and landing construction in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	As described in the management plan for road development. Monitoring data on an <i>ex-post</i> basis in the project scenario.
Value applied:	Variable on an <i>ex-post</i> basis in the project scenario - digitized in the project scenario on an <i>ex-post</i> basis if visible in remote sensing or captured by standing stocking estimates. Captured within the clearing component of the baseline scenarios.
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on expert opinion based on regional experience.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,BLOWDOWN,i,t}$, $f_{PRJ,BLOWDOWN,i,t}$
Data unit	unitless ($0 < f_{BSL,BLOWDOWN,i,t}$, $f_{PRJ,BLOWDOWN,i,t} < 1$)
Description	The proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Included within the natural mortality factors calculated in $f_{BSL,NATURAL,i,t}$, $f_{PRJ,NATURAL,i,t}$ by CBM-CFS3. Also captured by spatial monitoring if >4ha, which would be incorporated as a new polygon on an ex-post basis.
Value applied:	Zero for the baseline and project ex-ante calculations (part of the natural mortality modeling in CBM-CFS3).
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,BRANCH,i,t}$, $f_{PRJ,BRANCH,i,t}$
Data unit	unitless ($0 < f_{BSL,BRANCH,i,t}$, $f_{PRJ,BRANCH,i,t} < 1$)
Description	The proportion of aboveground tree biomass comprised of branches > 2 in diameter in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Calculated within CBM-CFS3.
Value applied:	Variable, see source data.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL, BUCKINGLOSS, i, t}$, $f_{PRJ, BUCKINGLOSS, i, t}$
Data unit	unitless ($0 < f_{BSL, BUCKINGLOSS, i, t}$, $f_{PRJ, BUCKINGLOSS, i, t} < 1$)
Description	The proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	CBM-CFS3 default values for British Columbia
Value applied:	CBM-CFS3 default values for British Columbia
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL, SNAGFALLDOWN, i, t}$, $f_{PRJ, SNAGFALLDOWN, i, t}$
Data unit	unitless ($0 < f_{BSL, SNAGFALLDOWN, i, t}$, $f_{PRJ, SNAGFALLDOWN, i, t} < 1$)
Description	The proportion of snag biomass in polygon, i, year, t, that falls over, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3.
Value applied:	Variable, depending on species and dbh. Modeled by species and age class within CBM-CFS3.
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL, LWDECAY, i, t}$, $f_{PRJ, LWDECAY, i, t}$
Data unit	unitless ($0 < f_{BSL, LWDECAY, i, t}$, $f_{PRJ, LWDECAY, i, t} < 1$)

Description	The annual proportional loss of lying dead biomass due to decay, in polygon i, year, t in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3.
Value applied:	CBM-CFS3 default values for British Columbia
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,SWDECAY,i,t}$, $f_{PRJ,SWDECAY,i,t}$
Data unit	unitless ($0 < f_{BSL,SWDECAY,i,t}$, $f_{PRJ,SWDECAY,i,t} < 1$)
Description	The proportional loss of snag biomass due to decay, in polygon, i, year, t, in the baseline and project cases, respectively.
Source of data	Modeled by CBM-CFS3.
Value applied:	CBM-CFS3 default values for British Columbia
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	$f_{BSL,DBGDECAY,i,t}$, $f_{PRJ,DBGDECAY,i,t}$
Data unit	unitless ($0 < f_{BSL,DBGDECAY,i,t}$, $f_{PRJ,DBGDECAY,i,t} < 1$)
Description	The proportional loss of dead belowground biomass due to decay, in polygon i, year, t, in the baseline and project cases, respectively.

Source of data	Modeled by CBM-CFS3.
Value applied:	CBM-CFS3 default values for British Columbia
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

Data / Parameter	E_M
Data unit	%
Description	An estimate of model error based on the relative area-weighted difference between model-predicted values of carbon storage and those values measured in field plots.
Source of data	Model output and field data (see Equation 60a).
Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of baseline and project emissions.
Comments	

Data / Parameter	E_I
Data unit	%
Description	An estimate of Inventory sampling error calculated as the 90% confidence limit of the area-weighted differences between the model-predicted values of carbon storage and those values measured in field plots.
Source of data	Model output and field data (see Equation 60c).

Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of baseline and project emissions.
Comments	

Data / Parameter	E_P
Data unit	%
Description	An estimate of total project error used to determine the uncertainty factor.
Source of data	Model output and field data (see Equation 60f).
Value applied:	Percent Calculated
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.
Purpose of Data	Calculation of baseline and project emissions.
Comments	

Data / Parameter	$E_{Ry,ERR,}$
Data unit	%
Description	The uncertainty factor calculated for year 'y' (See Section 6.5).
Source of data	Model output and field data (see Equation 60f).
Value applied:	18.94%
Justification of choice of data or description of measurement methods and procedures applied	Value determined using approach described in the VM0012 Methodology.

Purpose of Data	Calculation of baseline and project emissions and calculations of VCUy.
Comments	

Data / Parameter	MLF _y
Data unit	%
Description	The market leakage factor determined for year 'y'
Source of data	Determined based upon the approach defined in Section 4.3
Value applied:	0 %
Justification of choice of data or description of measurement methods and procedures applied	Value determined using the latest version of the VCS Market Leakage Tool as defined in Agriculture, Forestry and Other Land Use (AFOLU) Requirements v3.6 and specified in the VM0012 Methodology
Purpose of Data	Calculation of leakage.
Comments	

Data / Parameter	Component Ratio Method (Biomass Expansion Factors).
Data unit	Unitless
Description	Used to convert height and DBH into biomass of component pools. Utilized to calculate biomass measured in field plots.
Source of data	Modeled by CBM-CFS3 (FVS CRM).
Value applied:	CBM-CFS3 default settings for British Columbia
Justification of choice of data or description of measurement methods and procedures applied	CBM-CFS3 is widely accepted.
Purpose of Data	Required for calculation of baseline and project emissions.
Comments	

5.2 Data and Parameters Monitored

Data / Parameter	APRJ,i
Data unit	Hectares (ha)
Description	Area of forest land in polygon, i
Source of data	Latest version of the spatial inventory data.
Description of measurement methods and procedures applied	GIS inventory data updated from GPS coordinates and Remote Sensing data, including LiDAR or GPS survey. Updated yearly by the Project Proponent.
Frequency of monitoring/recording	Prior to every verification period.
Value applied:	Inventory data, hectares.
Monitoring equipment	Visual, satellite, aerial photos, LiDAR data
QA/QC procedures applied	Standard GIS QA/QC procedures. GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Calculation of project emissions in project area instance.
Calculation method	Determined from GIS software processes, area of polygons.
Comments	

Data / Parameter	APSP,i,
Data unit	Hectares (ha)
Description	Area of permanent sample plot (PSP) in polygon, i
Source of data	Field measurement.
Description of measurement methods and procedures applied	Fixed radius permanent sample plot design. See GreenRaise Standard Operating Procedures for procedures applied for plot sampling procedures. Completed by Project Developer.
Frequency of monitoring/recording	Plot measurements are repeated on 5-year intervals.

Value applied:	See compiled plot data MS Excel File. Plot is recorded in m2 and converted to hectares.
Monitoring equipment	GPS, measuring tape.
QA/QC procedures applied	GPS of plot center. GreenRaise Standard Operating Procedures (SOP) followed, including check cruising processes.
Purpose of data	Calculation of mean aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured
Comments	

Data / Parameter	DBH _{i,t}
Data unit	Centimeters (cm)
Description	Diameter at breast height measured for each tree in the sample plot at time, t
Source of data	Field measurements in sample plots.
Description of measurement methods and procedures applied	Field measurements in permanent sample plots. Measurement with DBH tape for trees ≥ 5cm in DBH at 1.3m height above ground. Completed by Project Developer.
Frequency of monitoring/recording	Individual plot tree re-measurements are repeated on 5-year intervals.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	DBH tape, data logger
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Calculation in aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured.
Comments	

Data / Parameter	Height $_{i,t}$
Data unit	Meters (m)
Description	Tree height measured for each tree in the sample plots at time, t
Source of data	Field measure in permanent sample plots.
Description of measurement methods and procedures applied	Field measurements in permanent sample plots. Measurement with vertex to nearest 0.1m for trees $\geq 5\text{cm DBH}$. Completed by Project Developer.
Frequency of monitoring/recording	Individual plot tree re-measurements are repeated on 5-year intervals.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Vertex IV type Hypsometer, a transit, a clinometer, a laser or other instrument designed for the measuring height.
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Calculation of mean aboveground biomass and in determination of Uncertainty Factor.
Calculation method	Measured
Comments	

Data / Parameter	BAG $_{i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Aboveground live tree biomass in polygon, i, year, t, in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from Height $_{i,t}$, DBH $_{i,t}$, and APSP $_i$. Completed by Project Developer.

Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Calculation of Uncertainty Factor.
Calculation method	Above ground biomass for each tree within a permanent sample plot will be calculated using plot data entered into CBM-CFS3.
Comments	Calculated

Data / Parameter	$B_{BG\ i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Average belowground live tree biomass in polygon, i, year, t, in the project.
Source of data	Estimated using information from above ground biomass calculations within permanent sample plots from $B_{AG\ i,t}$.
Description of measurement methods and procedures applied	Calculated using plot data in CBM-CFS3. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.

Calculation method	Calculated using plot data in CBM-CFS3.
Comments	

Data / Parameter	$B_{TOTAL\ i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Average total above and below ground live biomass in polygon, i, for year, t.
Source of data	Derived from average above ground biomass calculations within permanent sample plots.
Description of measurement methods and procedures applied	Sum of $B_{AGi,t}$ and $B_{BGi,t}$. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	Calculated using plot data in CBM-CFS3.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for above and below ground living tree biomass and in the determination of Uncertainty Factor.
Calculation method	Sum of $B_{AGi,t}$ and $B_{BGi,t}$ values.
Comments	Calculated

Data / Parameter	$CLB_{i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total carbon storage in live tree biomass in polygon, i, year, t, tC in the project case.
Source of data	Permanent sample plots.

Description of measurement methods and procedures applied	Calculated from $B_{TOTAL,i,t}$ and CF, sum of $B_{AG,i,t}$ and $B_{BG,i,t}$. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	As calculated by CBM-CFS3 from plot data, or $B_{TOTAL,i,t} * CF$
Comments	

Data / Parameter	$CDOM_{i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total carbon storage in dead organic matter in polygon, i, year, t,
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from $DOM_{SNAG,i,t}$ and $DOM_{LDW,i,t}$ and CF. Completed by Project Developer.
Frequency of monitoring/recording	Upon establishment of PSP. Every 5 years, thereafter.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.

Calculation method	As calculated by CBM-CFS3 from plot data. Or $(DOM_{SNAGi,t} + DOM_{LDWi,t}) * CF$
Comments	Calculated

Data / Parameter	$f_{PRJ,NATURAL,i,t}$
Data unit	unitless ($0 < f_{PRJ,NATURAL,i,t} < 1$)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the project case.
Source of data	Permanent sample plots, remote sensing.
Description of measurement methods and procedures applied	Height and dbh of dead trees in permanent sample plots will be recorded. Areas of stand replacing fires will be delineated if >1.0hectares. Completed by Project Developer.
Frequency of monitoring/recording	Annually in the case of fires, every 5 years in the case of individual plot trees
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Observation
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for project calculations
Calculation method	Observation in plot, and/or calculated by CBM-CFS3 and/or GIS/GPS delineation.
Comments	

Data / Parameter	$f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 < f_{PRJ,HARVEST,i,t} < 1$)
Description	The proportion of biomass removed by harvesting from polygon, i, in year, t, in the project case.

Source of data	Project Proponent Harvesting Records, inventory data.
Description of measurement methods and procedures applied	Volume derived from harvesting records. Modeled estimates of total biomass in polygon, i, used to derive parameter. Completed yearly by Project Proponent.
Frequency of monitoring/recording	Annually
Value applied:	See harvest area.
Monitoring equipment	GPS, remote sensing
QA/QC procedures applied	Data will be verified by ground-truthing and comparison with remote sensing information.
Purpose of data	Required for project calculations.
Calculation method	Modeled by CBM-CFS3 based on actual removals.
Comments	

Data / Parameter	$f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of biomass removed for road and landing construction in polygon, i, year, t, in the project case.
Source of data	Remote sensing, inventory data.
Description of measurement methods and procedures applied	Removals derived from remote sensing data and construction records. Completed by Project Proponent yearly.
Frequency of monitoring/recording	Annually
Value applied:	See GIS delineations construction records.
Monitoring equipment	GPS, satellite imagery, aerial photos, LiDAR
QA/QC procedures applied	Data will be verified by ground-truthing and comparison with remote sensing information.

Purpose of data	Required for project calculations.
Calculation method	Estimate of removals is multiplied by average carbon density within a polygon.
Comments	

Data / Parameter	DOM _{SNAG,i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total mass of dead organic matter contained in standing dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from Height _{i,t} , DBH _{i,t} , and APSP _i of dead trees measured in permanent sample plots. Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated by CBM-CFS3 from plot data.
Comments	Calculated

Data / Parameter	DOM _{LDW,i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total mass of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from the line intersect method (GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP)). Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated using the following field- measured parameters Li,t, dni,t, DLDWc,i,t , and N,t
Comments	Calculated

Data / Parameter	VLDW _{i,t}
Data unit	m ³ ha ⁻¹
Description	Total volume of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Calculated from the line intersect method (GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP)). Completed by Project Developer.
Frequency of monitoring/recording	Every 5 years.

Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Tape and visual inspection.
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Calculated using the following field- measured parameters $L_{i,t}$, $d_{ni,t}$, $D_{LDWC,i,t}$, and N_t
Comments	

Data / Parameter	$L_{i,t}$
Data unit	m
Description	Calculation of lying dead wood: Length of the transect used to determine volume of lying dead wood in the sample plot, at time, t (25m). Completed by Project Developer.
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Field measurements
Frequency of monitoring/recording	Every 5 years.
Value applied:	25m per transect.
Monitoring equipment	Metric measuring tape.
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of carbon stocks and Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	$D_{n,i,t}$
Data unit	cm
Description	Diameter of each piece n of dead wood along the transects in the sample plot at time, t). Used in calculation of lying dead wood
Source of data	Permanent sample plots.
Description of measurement methods and procedures applied	Lying dead wood to be sampled as described in the GreenRaise Monitoring (line intersect method). Four 25-m lines are established bisecting each plot on cardinal bearings (N,S,E,W) and specific diameters of the lying wood within three radius sizes intersecting the lines are measured. Minimum measurement diameter must not be less than 5 cm. Completed by Project Developer
Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Caliper, diameter tape
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	N_t
Data unit	unitless
Description	Calculation of dead organic material. Diameter of each piece n of dead wood along the transects in the sample plot at time, t).
Source of data	Permanent sample plots field measurement.
Description of measurement methods and procedures applied	Total number of wood pieces intersecting the transect in the sample plot, in time t, Completed by Project Developer

Frequency of monitoring/recording	Every 5 years.
Value applied:	See compiled plot data MS Excel File.
Monitoring equipment	Visual observation.
QA/QC procedures applied	GreenRaise Greenhouse Gas – Monitoring Standard Operating Procedures (SOP).
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	
Comments	

Data / Parameter	E_M / Mean model error for the project
Data unit	%
Description	An estimate of model error.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated value determined difference between of model-predicted values of carbon storage and those values measured in field plots (see Equation 60a). Completed by Project Developer
Frequency of monitoring/recording	At each verification.
Value applied:	14.53%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Equation (60a).
Comments	

Data / Parameter	E_I / Inventory error for the project
Data unit	%
Description	An estimate of inventory sampling error.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated as the 90% confidence limit of the area-weighted differences between the model-predicted values of carbon storage and those values measured in field plots. Completed by Project Developer
Frequency of monitoring/recording	At each verification.
Value applied:	12.91 %
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Equation (60c).
Comments	

Data / Parameter	E_P / Estimated project error
Data unit	%
Description	An estimate of total project error calculated as the sum of the model and inventory error terms.
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated as the sum of EM and EI (Equation 60e). Completed by Project Developer
Frequency of monitoring/recording	At each verification.
Value applied:	27.44 %

Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for determination of Uncertainty Factor.
Calculation method	Equation (60f).
Comments	

Data / Parameter	ER _{y,ERR} / Uncertainty Factor
Data unit	%
Description	The uncertainty factor calculated for year 'y'
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Calculated value. Completed by Project Developer
Frequency of monitoring/recording	At each verification and applied annually until the next verification.
Value applied:	18.945 %
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for project calculations.
Calculation method	
Comments	

Data / Parameter	MLF _y
Data unit	Percent

Description	The market leakage factor determined for year 'y'
Source of data	Model output and field data.
Description of measurement methods and procedures applied	Determined based upon the approach defined in Section 3. Completed by Project Developer
Frequency of monitoring/recording	At each verification
Value applied:	0%
Monitoring equipment	
QA/QC procedures applied	
Purpose of data	Required for calculation of leakage.
Calculation method	Value determined using the latest version of the VCS Market Leakage Tool as defined in Agriculture, Forestry and Other Land Use (AFOLU) Requirements v3.6 and specified in the VM0012.
Comments	

5.3 Monitoring Plan

The objective of the BigCoast monitoring plan is to reliably monitor changes in carbon stocks related to the calculation of VCU's prior to each verification. In particular, the program will reliably monitor changes in spatial forest inventory conditions and collect field data on carbon stocks (as per GreenRaise Monitoring SOP) to compare against modeled carbon stocks and to calculate the uncertainty factor.

Ongoing monitoring is the primary operational task for the project, which will be completed by the Project Proponent and supported by the Project Developer and Implementation Partner. Additional field monitoring may require the hiring of external field crews, all of which will be experienced in forest mensuration. The Project Proponent's onsite supervisor, Project Developer and Implementation Partner will be responsible for the adequate training of these external contractors, ensuring that all individuals involved are familiar with the sampling standard operating procedures.

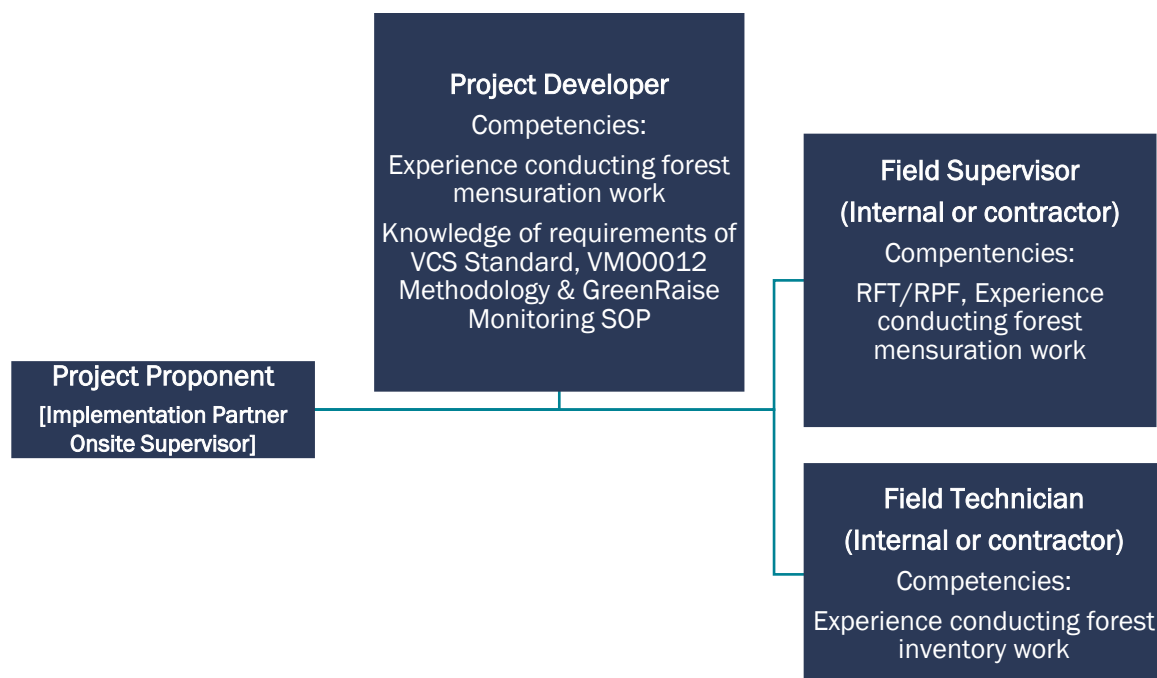


Figure 3 - Organization Structure (Monitoring Activities Personnel)

At each verification, reported on an annualized basis, the project will make the following inventory updates, as applicable:

1. Collect geo-referenced information on new project activities, including any forest management or silvicultural activities on any project instance that materially affects GHG emissions.
2. Annually monitor for forest disturbances through remote sensing, field observation, and/ or aerial observation and incorporate into GIS systems.

The inventory will be updated at a minimum, for:

- Natural disturbance events > 4 hectares (for example, fires, high mortality pest and disease areas, blowdown areas, slides, etc.).
- Project activities (e.g., timber harvesting/ thinning, road construction/ reclamation, reforestation/restoration, etc.). A minimum polygon size of 1 hectare can be used but is not a mandatory minimum.
- Unplanned anthropogenic disturbances (for example, non-de minimis illegal or unplanned harvests) affecting a non-de minimis amount of carbon stocks.

These monitored spatial elements will be updated in the Project Proponent's GIS inventory database (or equivalent) annually, or at minimum at each verification on an annualized basis.

5.3.1 Other Monitoring Requirements:

The Project Proponent will also document the following:

1. Activity shifting leakage (monitored annually, reported at each verification) – the project will report and assess the activity shifting leakage risks based on the timber harvest levels on lands owned or controlled by the Project Proponent that are outside the project area.

2. Market leakage calculations (at each verification, applied annually) - market leakage calculations will be confirmed at each verification using the latest plot inventory data and best available regional leakage area analysis.

At verification, the project will update the inventory, uncertainty calculations, and carbon calculations from field plot measurement data as outlined in Sections 5.3 and 6.3. The project may also undertake the following monitoring related tasks as appropriate:

1. Refine the project analysis units based on new forest inventory data or to meet the needs of future project instance(s).
2. Refine or calibrate carbon models based on updated inventory data, as appropriate.
3. Update or modify inventory polygons base on updated remote sensing, forest inventory data, or field truthing, or as a result of project activities or disturbances.

All inventory, data, and modeling changes must be applied equally to the baseline and project carbon calculations, as applicable.

5.3.2 Carbon Stock Field Plot Monitoring

BigCoast was initiated in 2018 with inventory work completed in 2021/2022 using a fixed radius and geo-located plot network for monitoring changes in stand-level forest volume and merchantable timber. A total of 43 field plots have been established within 21 analysis units. All historical and BigCoast project monitoring to date has been incorporated into the property inventory and GIS data updates used in this project design document.

The new plot monitoring program for carbon stocks established new permanent sample plots within the analysis units. Each plot collected data on overstory trees, dead standing trees, and lying deadwood. As part of ongoing project monitoring the project will periodically review the need for additional permanent sample plots or incorporation of other forest and carbon inventory updates or improvements over time. The methodology does not specify a number of plots, with error over the target (10% @ 90%CI) being accounted for in the uncertainty factor deduction (Section 6.5).

5.3.3 Monitoring Carbon Plot Sampling Design Overview:

The establishment of new permanent sample plots was initiated in 2021 by the Project Proponent. A total of 43 PSPs were planned for establishment distributed among 21 analysis units within the project area. Note: Analysis unit 1 (6.2ha) was merged with 3 as it occupied a small area. Subsequently, the plots established in the new combined analysis unit were used for verification of carbon estimates modelled in analysis unit 1 and 3

Plot monitoring and measuring techniques were completed as per the GreenRaise GHG – Monitoring SOP.

Plot Layout - Permanent plot locations were located using UTM coordinates randomly selected via GIS analysis tools. Plot locations were buffered by 60m from anthropogenic features such as roads and cutblocks, and from the analysis unit boarder. Buffering was completed to minimize the possible influence of edge effects on plot locations. A minimum buffer distance of 50m was also implemented between plots to ensure an appropriate distribution.

Size and Shape of Sample Plots – Permanent sample plots will be circular with a fixed radius of 11.28m (400m²).

Plot measurements – plots are installed, measured, and re-measured following the latest version of the GreenRaise Greenhouse Gas – Monitoring SOP as well as sampled for Coarse Woody Debris (CWD) for carbon accounting in specific portions of the Project Proponents managed lands. Plot measurements include live trees (aboveground live biomass); standing dead trees (aboveground dead biomass); and lying dead wood (aboveground dead biomass).

Given the dynamics of forest processes, the permanent plots will be re-measured at intervals not exceeding 5 field season years, beginning at the year of installation. As noted, permanent plots may be established over multiple years, and such re-measurement schedules will be tracked for each plot based on its establishment year.

5.3.4 Biomass Estimations from Plot Data:

Standing Live (Tree) and Dead tree biomass (Snag) – the volume of standing live and dead biomass was measured in the plots using a fixed radius plot method. The diameter at breast height (DBH = 1.3 m) and height of all live trees with a DBH greater than or equal to 5cm are measured. Height and diameter information is used to generate m³/ha values per plot.

The project proponent completes volume calculations for standing live and dead trees, and course woody debris. Tree based attributes (species, DBH, height, decay, etc.) are used to estimate individual tree volumes. Tree volumes within the plot are summed and multiplied by a plot multiplier based on plot size and live/dead status. This results in a m³/ha value per plot for standing live and standing dead (snag). All volume calculations are completed to standards set in the BC Provincial Cruise Compilation Manual (a step wise process is provided in Section 3.1. Compilation Sequence).

For standing live biomass (tree) is calculated using vol/ha for live trees only. Volumes are converted to tC/ha (biomass) utilizing Equations 1 – 5 within Boudewyn et al. 2007, with corresponding ecoregion and species-specific coefficients from the most up to date version of the CFS-CBM3 model (coefficients originating from Assumptions Composers – Volume-to-Biomass Parameters). These calculations are completed via a proprietary MS Excel spreadsheet.

Dead tree biomass (Snags) is calculated using m³/ha for dead trees only. The compiled volume is converted to biomass using Equation 1 only from Boudewyn et al. 2007, for stem wood biomass. This is the only component of interest for snags.

Lying Deadwood (DOM) – the mass of lying deadwood was measured in the plots using the line intersect method. Four marked 25m transect lines were measured at azimuth bearings (North, South, East, West) point of commencement from plot center. Three diameter classes of CWD were measured at intersected points along the transects within specific radius sizes and assigned to one of three

density classes; sound (1); intermediate (2); and rotten (3). The size class sampled along transects were as follows:

1. 0m to 5.64m radius all CWD diameters ≥ 5 cm.
2. 5.64m to 11.28m radius all CWD with diameters ≥ 12 cm
3. 11.28m to 25m radius all CWD with diameters ≥ 30 cm

The volume per unit area was calculated for each density class using Equations 60a-c (pg. 75), as described in the VM0012 methodology. The plot radii affect the multipliers used to estimate per hectare figures. Volumes per hectare were estimated using formula 1a, assuming pieces lie horizontal, in: Marshall *et. al* 2003. The totals volumes are summed across all transects and then divided by 4 (the number of transects in each plot) to estimate the per hectare figures for each plot.

Densities of lying deadwood in the decay classes were sourced from Woody Detritus Density and Density Reduction Factors for Tree Species in the United States: A Synthesis (Mark E. Harmon, 2007). The total mass of lying deadwood was calculated as the average of all transects.

$$\text{Volume (m}^3 \text{ /ha)} = \pi^2 / 8L \sum d_n^2$$

Where d_n = diameter (cm) of each of the n pieces intersecting the line, and L = the length of the line.

5.3.5 Quality Assurance/Quality Control Measures (QA/QC):

The GreenRaise Greenhouse Gas-Monitoring SOP includes procedures for: (1) collecting reliable field measurements; (2) verifying laboratory procedures; (3) verifying data entry and analysis techniques; and (4) data maintenance and archiving.

QA/QC for Field Measurements - the plot network was installed by trained field crews with previous experience installing similar permanent plots and forestry related experience. The GreenRaise SOP requires blind check-cruises of a minimum of 10% of the plots, with 100% re-measurement of all variables which meet the minimum DBH, height, and tree count accuracy thresholds (+/- 10% standard error at 90% confidence interval). This meets the methodology QA/QC 10% requirement. Data results will be reported in the project monitoring plan for each verification.

QA/QC for Laboratory Measurements - no laboratory measurements were taken for the sampling, and so this section is not applicable.

QA/QC for Data Entry – Field data is collected on digital data recorders and is transferred electronically to minimize data entry and transfer errors. If there are anomalies that cannot be resolved noted within plot data, the plot will be re-measured, or data will be omitted from the analysis.

QA/QC for Data Archiving – The Implementation Partner has document control procedures which apply to the carbon monitoring data, including retaining the following for 2 years past the duration of the project: original electronic copies of the field measurement, check plots, and related data summaries; copies of monitoring data analyses, models, model input and output files, carbon calculations required for this methodology, GIS inventory dated by year, and copies of the monitoring reports; records of the version and relevant change history of software or data storage media changed between monitoring periods.

5.3.6 Addressing Non-Conformities

Non-conformities regarding plot monitoring and spatial analysis will be addressed upon submission. Project Proponent forest managers and hired forestry contractors will be responsible for addressing non-conformities. Issues will be solved by returning to the plot to re-affirm measurements, or to ground verify concerns regarding spatial data. Other non-conformities will be addressed, as necessary. Non-conformities will then be reviewed to verify effective completion.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Data and Parameters Monitored¹⁴

Data / Parameter	APRJ,i
Data unit	Hectares (ha)
Description	Area of forest land in polygon, i
Value applied:	44,022 ha
Comments	Total area of project instance for this monitoring period.

Data / Parameter	APSP,i,
Data unit	Hectares (ha)
Description	Area of permanent sample plot (PSP) in polygon, i
Value applied:	Hectares for calculation in Uncertainty Factor.
Comments	Calculated statistical uncertainty in forest carbon inventories compared to Remsoft Woodstock and CBM CFS3 model outputs.

Data / Parameter	DBH _{i,t}
Data unit	Centimeters (cm)
Description	Diameter at breast height measured for each tree in the sample plot at time, t
Value applied:	See compiled plot data MS Excel File.
Comments	Diameters measured in each permanent sample plots contribute to factors used to calculate above ground carbon stores measured in analysis unit plot observations

¹⁴ Data and parameters monitored to be used for all monitoring periods.

Data / Parameter	Height i,t
Data unit	Meters (m)
Description	Tree height measured for each tree in the sample plots at time, t
Value applied:	See compiled plot data MS Excel File.
Comments	Tree heights measured in each permanent sample plot contribute to parameters used to calculate above ground carbon stores measured in analysis unit plot observations

Data / Parameter	BAG i,t
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Aboveground live tree biomass in polygon, i , year, t , in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of above ground live tree biomass carbon stocks (Height, DBH, APSP, i) Parameters used for uncertainty calculations.

Data / Parameter	BBG i,t
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Average belowground live tree biomass in polygon, i , year, t , in the project.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of below ground tree biomass carbon stocks, Parameters used for uncertainty calculations.

Data / Parameter	B _{TOTAL} i,t
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)

Description	Average total above and below ground live biomass in polygon, i, for year, t.
Value applied:	Calculated using plot data in CBM-CFS3.
Comments	Calculation of above and below ground tree biomass carbon stocks, Parameters used for uncertainty calculations. Sum of BAG _{i,t} and BBG _{i,t} .

Data / Parameter	CLB _{i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total carbon storage in live tree biomass in polygon, i, year, t, tC in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Calculation of live tree biomass carbon stocks, parameters used for uncertainty calculation.

Data / Parameter	CDOM _{i,t}
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total carbon storage in dead organic matter in polygon, i, year, t,
Value applied:	See compiled plot data MS Excel File.
Comments	Annual change in dead organic matter carbon stocks. Parameters used in uncertainty calculation.

Data / Parameter	f _{PRJ,NATURAL,i,t}
Data unit	unitless (0 < f _{PRJ,NATURAL,i,t} < 1)
Description	The proportion of biomass that dies from natural mortality in polygon, i, year, t, in the project case.
Value applied:	See compiled plot data MS Excel File

Comments	Annual change in natural mortality in carbon stocks. Factor in uncertainty calculation.
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Data / Parameter	$f_{PRJ,HARVEST,i,t}$
Data unit	unitless ($0 < f_{PRJ,HARVEST,i,t} < 1$)
Description	The proportion of biomass removed by harvesting from polygon, i, in year, t, in the project scenario.
Value applied:	Volumes, modeled by CBM-CFS3 based on actual removals.
Comments	Parameters used for project emission calculations

Data / Parameter	$f_{PRJ,DAMAGE,i,t}$
Data unit	unitless ($0 < f_{PRJ,DAMAGE,i,t} < 1$)
Description	The proportion of biomass removed for road and landing construction in polygon, i, year, t, in the project case.
Value applied:	Volumes, based on monitored removals. Change in carbon stocks annually.
Comments	Parameters used for project emission calculations

Data / Parameter	$DOM_{SNAG,i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)
Description	Total biomass of dead organic matter in standing dead wood in polygon, i, year, t in the project scenario.
Value applied:	Change in carbon stock annually
Comments	Parameters used for uncertainty calculations.

Data / Parameter	$DOM_{LDW,i,t}$
Data unit	t d.m. ha ⁻¹ (d.m. = dry matter)

Description	Total mass of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used for uncertainty calculations.

Data / Parameter	VLDW,i,t
Data unit	m ³ ha ⁻¹
Description	Total volume of dead organic matter contained in lying dead wood in polygon, i, year, t in the project case.
Value applied:	See compiled plot data MS Excel File
Comments	Parameters used in uncertainty calculation.

Data / Parameter	L _{i,t}
Data unit	m
Description	Used in calculation of mean mass of dead organic material, lying dead wood: Length of the transect used to determine volume of lying dead wood in the sample plot, at time, t (25m)
Value applied:	25m transect
Comments	Parameters used in uncertainty calculations.

Data / Parameter	D _{n,i,t}
Data unit	cm
Description	Diameter of each piece n of dead wood along the transects in the sample plot at time, t). Used in calculation of lying dead wood
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used in uncertainty calculations.

Data / Parameter	N_t
Data unit	unitless
Description	Calculation of dead organic material. Diameter of each piece n of dead wood along the transects in the sample plot at time, t).
Value applied:	See compiled plot data MS Excel File.
Comments	Parameters used in uncertainty calculations.

Data / Parameter	E_M / Mean model error for the project
Data unit	%
Description	An estimate of model error.
Value applied:	14.52 %
Comments	Equation (60a).

Data / Parameter	E_I / Inventory error for the project
Data unit	%
Description	An estimate of inventory sampling error.
Value applied:	12.9%
Comments	Equation (60f).

Data / Parameter	E_P / Estimated project error
Data unit	%
Description	An estimate of total project error calculated as the sum of the model and inventory error terms.
Value applied:	27.52 %

Comments	Equation (60f).
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Data / Parameter	ER _{y,ERR} / Uncertainty Factor
Data unit	%
Description	The uncertainty factor calculated for year 'y'
Value applied:	18.93%
Comments	Parameters used in project emission calculations

Data / Parameter	MLF _y
Data unit	Unitless
Description	The uncertainty factor calculated for year 'y'
Value applied:	0
Comments	Parameters used in leakage calculations

6.2 Baseline Emissions

6.2.1 Overview of Baseline and Project Scenarios using Woodstock, CBM-CFS3 Outputs and Microsoft Excel Applications

Remsoft's Woodstock model, the CBM-CFS3 model and supporting Excel spreadsheets were developed to house the data, and to perform carbon modeling by PAI. Data from the CBM-CFS3 output 'Delta Ecosystem Reports' and Woodstock Reports were exported into excel spreadsheets for further analysis consistent with the VM0012 methodology. The reports consist of tables that contain the applicable carbon pools and include reference equations as presented in the methodology. As a result of the proponent's Timber Supply Analysis ((TSA) completed via Woodstock Runs (WS)) input data is within 5-year periods, which is then interpolated evenly into 1-year increments. Modelling covers all analysis units in both the project and baseline scenarios.

Polygon-based forest inventory data, in a geo-spatial database (TSA dataset), was used to populate the Woodstock Model runs which were completed externally¹⁵. Corporate operational constraints that reflect the real-world operational environment were applied to produce the Baseline Scenario. These corporate operational constraints, as defined within the TSA Documents, are considered proprietary information but are available for the purpose of validation and verification. The main driver of the Timber Supply Analysis to date has been to derive a fair value of the timberlands/ enterprise valuation and generate a long-term harvest flow with a positive net present value (+NPV). To accommodate the developing carbon opportunities, a similar process was integrated for the carbon modeling and valuation.

For the initial period (01-January-2018 to 31-12-2021) the Woodstock model was run separately for the TimberWest and Island Timberlands properties as this period was effectively prior to amalgamation of the two companies under Mosaic management. Forward looking modelling (as of 2022) uses a combined landbase as all management is currently integrated including long-term harvest forecasting.

The project polygons included in the PAI were identified through an iterative process that considered social and environmental constraints along with business analysis to reflect return on investment. All polygons were tagged within the TSA data set to allow for tracking and further down-stream analysis.

Woodstock results were then used to populate CBM-CFS3 input files (i.e., classifiers, age classes, disturbance types, events, inventory and transitions). Each polygon included sufficient information (Classifiers/ Themes) to allow filtering into its assigned analysis unit (Table 14. Description of Forest Analysis Units Defined in the Project Area).

Theme groupings were used in combination with polygon area to match up the modeled inventory polygon to the correct carbon yield curve data. The CBM-CFS3 derived stand and carbon curves are modeled on an assumed fully stocked representative stand in each AU and applies carbon and merchantable volume outcomes for each polygon based on the applicable allometric formulas. The model includes discrete 'Runs' that represent the project (PRJ - deferred harvest) and specific baseline disturbances/ harvest activities (BSL – harvest).

The CBM-CFS3 then simulates and tracks the fate of carbon in all applicable carbon pools over time by polygon, including for Wood Products pool after any scheduled event. Carbon calculations can then be summarized for the project and baseline scenarios for each project year across the project area.

Baseline emissions are calculated by applying a Baseline 'disturbances' to each AU, and then modeling the baseline activities and the related carbon flows using CBM-CFS3. The methods described are equivalent to the equations and processes outlined in VM0012.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

¹⁵ All Woodstock model runs were completed by Ecora (<https://ecora.ca/>). Ecora has providing modeling support to Island Timberlands since 2009 and for Mosaic since 2019.

6.2.2 Calculating Baseline Scenario Live Biomass Gain

For the Historic Baseline Scenario (as described in Section 3.4), a set of historic baseline activities (disturbances) was based on harvest details within the Timber Supply Analysis utilizing Net Present Value (NPV) principles for estate management. The annual harvest volume has been determined by forward looking harvest volumes and are driven by site productivity and market demand. All baseline management activities are assumed to occur/ begin at year 1 (2018).

Live biomass gain ($\Delta C_{BSL,G,t}$, Eqn 4,5a-b) is calculated by CBM-CFS3 based on the project area and stratifications into analysis units. Regionally specific forest dynamics (BC Admin & Pacific Maritime), and the related carbon curves discussed above, are tracked, and reported by carbon pool (Aboveground Live, Belowground Live), and reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009).

6.2.3 Calculating Baseline Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{BSL,L,t}$, Eqn 6,7,8,9) is calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dynamics, including natural tree mortality, harvesting scenario felling/ removals, blowdown, and any other biomass loss. Generally, mortality related live biomass is shifted into dead biomass pools by CBM-CFS3 (Aboveground Standing Dead (snags), Aboveground Downed and Dead Wood (DOM), Belowground DOM), which are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009).

6.2.4 Calculating Baseline Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{BSL,DOM,t}$, Eqn 10,11a-b,12,13,14a-b,15,16,17a-d) are calculated by CBM-CFS3 based on the project area stratifications, regionally specific forest dynamics and the related carbon curves discussed above. Default parameters and algorithms within CBM-CFS3 model and track all stand dead wood dynamics, including standing dead, downed dead, and below ground dead organic matter. CBM-CFS3 uses the regionally specific variant data and related parameters to model and track dead organic matter between carbon pools (Aboveground Dead (i.e. Stem Snags), Belowground Dead, Aboveground Slow DOM (VM0012 calls this Lying Dead Wood)), and decay temperate related decay within each pool.

Additionally, CBM-CFS3 tracks dead organic matter dynamics related to harvesting (slash) or other events when applied. The project uses the default decay factors and dead matter dynamics that are set within the CBM-CFS3 model and specific to the variant dataset. The results of dead organic matter dynamics are reported in the Delta Ecosystem Reports. Additional details about related model default values, functionality, and parameters are found in Kull *et al.* (2019) & Kurz *et al.* (2009). Generally, carbon stocks are transitioned between dead biomass pools, and emitted as they decayed.

6.2.5 Calculating Baseline Scenario Harvested Wood Products (HWP)

Harvested Wood Product dynamics ($\Delta C_{BSLHWP,t}$, Eqn. 18,19,20 (not used),21,22a-c,23) are calculated with a derivative pivot table based on forecast harvest volumes from Woodstock (i.e. merchantable volume generated during the harvest period (m^3) converted using species-specific wood densities along with a Carbon Fraction ($CF = 0.5$)).

For the purposes of Step 2 (carbon contained in harvested timber after milling) Forest Product Conversion Factors for the UNECE Region published by the United Nations Economic Commission for Europe (ECE/TIM/DP/49) was used to determine the total carbon in harvested timber that will enter the wood products pool by product type accounting for mill efficiencies and estimated product disposition percentages ($C_{BSL,MILL,h}$; t C). The gross quantity of carbon contained in harvested timber for each of the four product types (k) described in Step 1 must be decremented to account for losses during processing. This loss is calculated within Mosaic - BSL HWP (Sept '22) excel spread sheet specifically tab 'Step 2 (Mill)'. Refer to the Appendices for additional information.

Step 3 calculates (carbon storage in medium-term and long-term wood products) the total carbon lost in short-lived products and stored in medium-term and long-term products was using reference tables and factors from Smith, et al (2006). The result is a fraction of the Wood Products pool being emitted or stored annually for each In-Use category based on product, decay, and storage factors.

Constants from Smith, et al (2006) Table 6 – the Northwest Softwoods, Saw Logs and Pulpwood; along with the Northwest Hardwood tables were applied. The respective volumes were calculated by species and product type (hardwood sawlog and pulpwood are added back together to use these tables).

Constants were used from the relevant “In Use” column to finalize calculations for the following HWP categories:

- Short-lived HWP – multiplied (Year 1 – 3 look-up factor) for each of the tables against the respective remaining In-Use carbon volumes. This calculates the fraction of net Merch Carbon Removed that is In-Use as Short-lived HWP. Following VM0012, the sum of all Short-lived HWP is assumed to be emitted immediately.
- Long-lived HWP – applied the look-up factor for Year 100 for each of the tables against the respective remaining In-Use carbon volumes. This calculates the fraction of net Merch Carbon Removed that is In-Use as Short-lived HWP. Following VM0012, the sum of all Long-lived HWP is assumed to be permanently stored.
- Medium-Lived HWP – the difference between the carbon remaining In-Use at Year 3 and at Year 100 is then calculated using each table look-up factors and carbon volumes, respectively to calculate the Medium-Lived HWP. The sum of all Medium-Lived HWP is then modelled to emit on a straight line 20-year decay curve, starting in year 0 and being fully emitted in year 20.

Note that the remaining Merch Carbon Removed after accounting for Short-, Medium-, and Long-lived HWP is emitted immediately as a combination of emissions due to waste carbon being used for Energy and Emitted w/o Energy.

6.2.6 Fossil fuel emissions associated with logging, transport, and manufacture

BigCoast has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions ($\Delta C_{BSL,EMITFOSSIL,t}$, Eqn. 24,25,26,27) from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e., clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups).

Default values in VM0012 Table 4 have been used. All calculations in support of this is within: Emissions_BSL_Estimate (Aug '22) spreadsheet. See Appendix

Woodstock (Remsoft) output reports that forecast species, product groups (e.g., CNS - Chip 'n Saw) and related harvest volumes (m^3) for each planning period were used for the following calculations. Results are then converted to Merchantable Carbon pool using species specific wood densities along with a Carbon Fraction (CF = 0.5) providing Tonnes of Carbon (tC) harvested for each planning period. This is equivalent to $C_{BSL,TIMBER,h}$ as represented by Eq. 20 being the carbon contained in timber harvested in period h.

The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as:

$$C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t} \text{ (Eq. 24)}$$

Each of the carbon components are calculated as noted below:

Equation 25:

$C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr⁻¹).

$$C_{BSL,EMITHARVEST,t} = \sum [C_{BSL,TIMBER,h}] \bullet CHARVEST$$

All timber in the BigCoast project is harvest via clearcutting and the default value for $CHARVEST$ is used.

Equation 26:

$C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr⁻¹).

$$C_{BSL,EMITTRANSPORT,t} = \sum [C_{BSL,TIMBER,h}] \bullet \sum (f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet C_{TRANSPORTk})$$

$f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; 0 < 1). All timber in the BigCoast project is transported by truck.

$d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); The Woodstock outputs contain information on the 'basin' (watershed) timber was harvested in. Haul distance from the cutblock to either a Mosaic Dryland Sort (DLS), chipper sites or direct delivery customers. The boundaries of this emission calculation are from cutblocks (as defined by basins) to log sorts or direct delivery customers on Vancouver Island and do not include towing to Vancouver or any other type of log transportation (trans-national log export). This is conservative in nature.

The transport distance is calculated using an average haul distance (km) for each Sub-basin to the closest or relevant log dump, sort, or mill within the project area. The average speed is travelled by logging trucks is 60 km/hr. A weighted average by species and basin is used.

$C_{TRANSPORTk}$ is the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k. The table 4 for default values are used.

Equation 27

$C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr⁻¹).

$$C_{BSL,EMITMANUFACTURE,t} = \sum [C_{BSL,TIMBER,h}] \bullet \sum (f_{BSL,PRODUCTk} \bullet C_{MANUFACTUREk})$$

$C_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k;

The following product groups from Woodstock are assigned to the following product type (k) categories:

4. Pulpwood (Chemical): PLP - pulp
5. Saw Log: CNS – Chip n’ Saw, GNG – Gang, MER – Merch Log, Std - Standard, SHN – Shake/Shingle
6. Veneer/ plywood: PEL - Peeler

For each product type (k) the table 4 for default values are used.

6.2.7 Baseline Scenario GHG Emissions Calculation Summary

The CBM-CFS3 model and the supporting spreadsheets were used based on spatial forest inventory data to calculate and track all annual changes in both the live biomass ($\Delta C_{BSL,LB,t}$) and dead organic matter pools ($\Delta C_{BSL,DOM,t}$) for the baseline scenario in a method consistent with the formulas in VM0012. Carbon storage changes in harvested wood products ($\Delta C_{BSI,HWP,t}$) and fossil fuel emissions ($\Delta C_{BSL,EMITFOSSIL,t}$) summarized net carbon balances, and other deductions and buffer discounts were determined in the supporting spreadsheets.

The total annual carbon balance in year, t, for the baseline scenario ($\Delta C_{BSL,t}$, in t C yr⁻¹) was calculated as:

$$\Delta C_{BSL,t} = \Delta C_{BSL,P,t} \quad (1)$$

where:

$\Delta C_{BSL,P,t}$ is the annual change in carbon stocks in all pools in the baseline across the project area area (including all project polygons); t C yr⁻¹.

The annual change in carbon stocks in all pools in the baseline across the project activity area ($\Delta C_{BSL,P,t}$; t C yr⁻¹) was calculated as:

$$\Delta C_{BSL,P,t} = \Delta C_{BSL,LB,t} + \Delta C_{BSL,DOM,t} + \Delta C_{BSI,HWP,t} \quad (2)$$

where:

$\Delta C_{BSL, LB, t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr⁻¹

$\Delta C_{BSL, DOM, t}$ = annual change in carbon stocks in dead organic matter; t C yr⁻¹

$\Delta C_{BSI, HWP, t}$ is the annual change in carbon stocks associated with harvested wood products, t C yr⁻¹.

The annual change in carbon stocks in living tree biomass (above- and belowground) in the baseline scenario ($\Delta C_{BSL, LB, t}$; t C yr⁻¹) was calculated as:

$$\Delta C_{BSL, LB, t} = \Delta C_{BSL, G, t} - \Delta C_{BSL, L, t} \quad (3)$$

where:

$\Delta C_{BSL, G, t}$ = annual increase in tree carbon stock from growth; t C yr⁻¹

$\Delta C_{BSL, L, t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr⁻¹.

The annual change in carbon stocks in dead organic matter (DOM) ($\Delta C_{BSL, DOM, t}$; t C yr⁻¹) in the baseline scenario was calculated as:

$$\Delta C_{BSL, DOM, t} = \Delta C_{BSL, LDW, t} + \Delta C_{BSL, SNAG, t} + \Delta C_{BSL, DBG, t} \quad (10)$$

where:

$\Delta C_{BSL, LDW, t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr⁻¹

$\Delta C_{BSL, SNAG, t}$ = change in snag carbon stock in year, t; t C yr⁻¹

$\Delta C_{BSL, DBG, t}$ = change in dead below-ground biomass carbon stock in year, t; t C yr⁻¹.

The annual change in emissions associated with the production of harvested wood products (HWP), $\Delta C_{BSI, HWP, t}$, is calculated as:

$$\Delta C_{BSI, HWP, t} = \Delta C_{BSL, STORHWP, t} - \Delta C_{BSL, EMITFOSSIL, t} \quad (18)$$

$\Delta C_{BSL, STORHWP, t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr⁻¹)

$\Delta C_{BSL, EMITFOSSIL, t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.

6.3 Project Emissions

Project emissions and carbon flows are calculated in the same manner as the baseline emissions discussed in the Section 4.1. Calculations use the same forest inventory data, analysis units and polygons, and modeling tools under the Project Scenario activities. Project and Baseline Scenarios and polygon versions of each are tracked and calculated simultaneously in the supporting spreadsheets using the same parameters, outputs, and analysis under each scenario. In the project scenario, carbon flows are modeled using project activities which includes the focus on maintaining forest health throughout the term of the project.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

Project activities affecting GHG emissions were carried out during the initial project period (01-January-2018 to 31-December-2021) however, no project scenario activities were projected on an *ex-ante* basis. Future years may include various project forest management activities that affect *ex-post* carbon stocks which will be monitored and reported on in future verifications (e.g. salvage due to significant fire or forest health loss). Project activities will be based on actual monitoring results (see Section 5) and any resulting emissions netted against emission reductions.

The methods described are equivalent to the equations and processes outlined in VM0012.

6.3.1 Calculating Project Scenario Live Biomass Gain

Live biomass gain ($\Delta C_{PRJ,G,t}$, Eqn 32,33a-b) is calculated the same as in the Baseline Scenario (CBM-CFS3), Section 6.2.2 using project area (instance), and analysis unit information.

6.3.2 Calculating Project Scenario Live Biomass Loss

Live biomass loss ($\Delta C_{PRJ,L,t}$, Eqn 34,35,36,37) is calculated the same as in the Baseline Scenario (CBM-CFS3), Section 6.2.3 using project area stratifications, regionally specific forest dynamics and the related carbon curves data.

6.3.3 Calculating Project Scenario Dead Organic Matter Dynamics

Dead organic matter dynamics ($\Delta C_{PRJ,DOM,t}$, Eqn 38,39a-b,40,41,42a-b,43,44,45a-d) are calculated the same as in the Baseline Scenario, Section 6.2.4 using project scenario polygons and data.

6.3.4 Calculating Project Scenario Harvested Wood Products (HWP)

Harvested Wood Product dynamics ($\Delta C_{PRJ,HWP,t}$, Eqn 46,47,48,49,50a-c,51,52,53,54,55) are calculated the same as in the Baseline Scenario, Section 6.2.5 with respect to any timber harvesting in the project scenario. Currently there is no timber harvesting in the project scenario, although it may occur in the future (forest fire, health salvage operations).

6.3.5 Fossil fuel emissions associated with logging, transport, and manufacture

BigCoast has chosen to include the 'optional' pool of fossil fuel emissions (VM0012 Table 2). The annual change in fossil fuel emissions ($\Delta C_{PRJ,EMITFOSSIL,t}$, Eqn. 52,53,54,55) from harvesting and processing of the various wood products applies to fuel emissions associated with harvesting of raw material (i.e. clear felling), transport of raw material (trucking and haul distance) and manufacturing of raw material (into product groups). Emissions are calculated the same as in the Baseline Scenario, Section 6.2.6 with respect to any timber harvesting in the project scenario. Currently there is no timber harvesting in the project scenario, although it may occur in the future (forest fire, health salvage operations).

6.3.6 Project Scenario GHG Emissions Calculation Summary

The CBM-CFS3 and supporting spreadsheets were used in combination with the spatial forest inventory data to calculate and track annual changes in both the biomass ($\Delta C_{PRJ, LB, t}$) and dead organic matter pools ($\Delta C_{PRJ, DOM, t}$) for the project scenario. Changes in carbon storage in harvested wood products ($\Delta C_{PRJ, HWP, t}$) and fossil fuel emissions ($\Delta C_{PRJ, EMITFOSSIL, t}$) and summarized net carbon balances and buffer discounts were determined within the applicable spreadsheets.

The total annual carbon balance in year, t , for the project scenario ($\Delta C_{PRJ, t}$, in $t\ C\ yr^{-1}$) was calculated as:

$$\Delta C_{PRJ, t} = \Delta C_{PRJ, P, t} \quad (29)$$

where:

$\Delta C_{PRJ, P, t}$ is the annual change in carbon stocks in all pools in the baseline across the project activity area; $t\ C\ yr^{-1}$.

The annual change in carbon stocks in all pools in the project scenario across the project activity area ($\Delta C_{PRJ, P, t}$; $t\ C\ yr^{-1}$) was calculated as:

$$\Delta C_{PRJ, P, t} = \Delta C_{PRJ, LB, t} + \Delta C_{PRJ, DOM, t} + \Delta C_{PRJ, HWP, t} \quad (30)$$

where:

$\Delta C_{PRJ, LB, t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); $t\ C\ yr^{-1}$

$\Delta C_{PRJ, DOM, t}$ = annual change in carbon stocks in dead organic matter; $t\ C\ yr^{-1}$

$\Delta C_{PRJ, HWP, t}$ is the annual change in carbon stocks associated with harvested wood products, $t\ C\ yr^{-1}$.

The annual change in carbon stocks in living tree biomass (above- and belowground) in the project scenario ($\Delta C_{PRJ, LB, t}$; $t\ C\ yr^{-1}$) was calculated as:

$$\Delta C_{PRJ, LB, t} = \Delta C_{PRJ, G, t} - \Delta C_{PRJ, L, t} \quad (31)$$

where:

$\Delta C_{PRJ, G, t}$ = annual increase in tree carbon stock from growth; $t\ C\ yr^{-1}$

$\Delta C_{PRJ, L, t}$ = annual decrease in tree carbon stock from a reduction in live biomass; $t\ C\ yr^{-1}$.

The annual change in carbon stocks in dead organic matter (DOM) ($\Delta C_{PRJ, DOM, t}$; $t\ C\ yr^{-1}$) in the project scenario was calculated as:

$$\Delta C_{PRJ, DOM, t} = \Delta C_{PRJ, LDW, t} + \Delta C_{PRJ, SNAG, t} + \Delta C_{PRJ, DBG, t} \quad (38)$$

where:

$\Delta C_{PRJ, LDW, t}$ = change in lying dead wood (LDW) carbon stocks in year, t ; $t\ C\ yr^{-1}$

$\Delta C_{PRJ, SNAG, t}$ = change in snag carbon stock in year, t ; $t\ C\ yr^{-1}$

$\Delta C_{PRJ, DBG, t}$ = change in below-ground carbon stock in year, t ; $t\ C\ yr^{-1}$.

The annual change in the carbon stored in harvested wood products (HWP), ($\Delta C_{PRJ, HWP, t}$; $t\ C\ yr^{-1}$) in the project scenario was calculated as:

$$\Delta C_{PRJ, HWP, t} = \Delta C_{PRJ, STORHWP, t} - \Delta C_{PRJ, EMITFOSSIL, t} \quad (46)$$

$\Delta C_{PRJ,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr⁻¹)

$\Delta C_{PRJ,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.

6.4 Leakage

6.4.1 Activity Shifting Leakage

As per the procedures outlined within Section 4.3.1, it has been determined that no activity shifting leakage occurred within the verification period of 01-January-2018 to 31-December-2021.

Actual harvest amounts combined with deferred harvest amounts all remained below the acceptable benchmark (as determined from the 2013 – 2017 modelled harvest volumes). Figure 4 below displays the analysis completed.

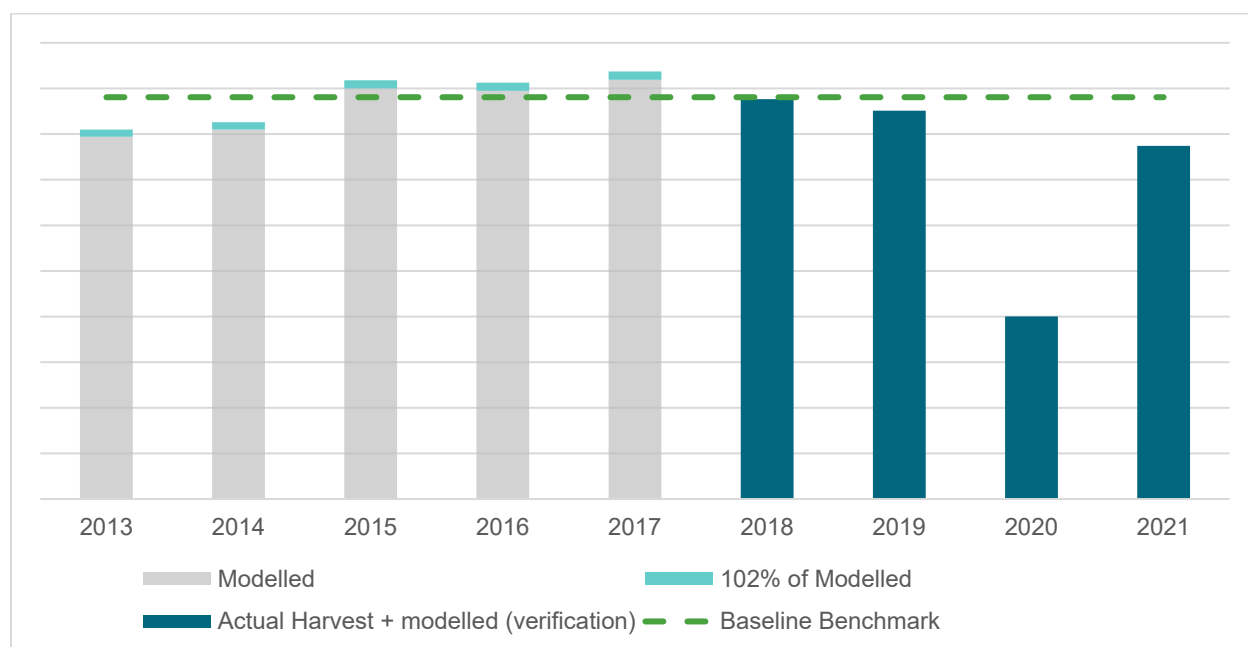


Figure 4. Verification period activity shifting leakage assessment

For the verification period, volumes of actual harvest, as well as volumes attributed to the deferred harvest within the carbon project were collected and compared to the pre-determined benchmark. Total harvest volumes each year were below the benchmark level, therefore representing no activity shifting leakage.

Equations used may be referenced within the section or noted in Appendix 5 of this document.

6.4.2 Market Leakage

The market leakage assessment described within Section 4.3.2 was completed for the verification period. The resulting market leakage factor (MLF_y) of zero is applied within the net GHG Emission Reductions and Removals calculations.

6.5 Net GHG Emission Reductions and Removals

6.5.1 Calculation of the Uncertainty Factor

As per the methodology monitoring section specification, the project has installed at least one field plot in each Analysis Unit. The project has installed 43 permanent carbon plots in 2021 and 2022.

The project-level uncertainty factor is calculated by a function within the *VM0012 – Uncertainty – NFI (Nov'24)* excel spreadsheet, following the formulas below:

Step 1 – the project calculated the average percent model error (E_M) for the project based on the average area-weighted difference between measured values in monitored plot observations and model-predicted values using Equations 60a, b.

$$E_M = 100 \cdot (\sum y_{d,h,i} / \sum (A_{PRJ,h} \cdot y_{m,h,i})) \quad (60a)$$

where:

The summation is across all plot observations, i , and across all analysis units, h ;

$$y_{d,h,i} = A_{PRJ,h} \cdot (y_{p,h,i} - y_{m,h,i}) \quad (60b)$$

E_M = Mean model error for the project (%)

$y_{d,h,i}$ = the area-weighted difference between measured and predicted carbon storage in analysis unit, h , plot observation, i (t C)

$y_{m,h,i}$ = carbon storage measured in analysis unit, h , plot observation, i (t C ac⁻¹)

$y_{p,h,i}$ = carbon storage predicted by model for analysis unit, h , plot observation, i (t C ac⁻¹) $A_{PRJ,h}$ = area of project analysis unit, h (ac)

Step 2 – The project calculated the inventory error (E_I) at a 90 percent confidence interval expressed as a percentage of the mean area-weighted inventory estimate from the measured plots. Inventory error is estimated based upon the difference between modeled and measured values for monitoring plots established in polygons grouped within analysis units.

Inventory error, E_I , is estimated by first calculating the standard error of the area-weighted differences between the plot observation measurement and the associated model-predicted carbon storage (both on a per acre basis) for analysis units. The standard error is then multiplied by the t -value for the 90 percent confidence interval. Finally, E_I is expressed in relative terms (in Equation 60c) by dividing the 90% confidence interval of the area-weighted differences between predicted and measured values in all plots by the area-weighted average of the measured values in all monitoring plots.

$$E_I = 100 \cdot [SE \cdot 1.654 / ((1/N) \cdot \sum (A_{PRJ,h} \cdot y_{m,h,i}))] \quad (60c)$$

where:

E_I = Inventory error for the project (%)

SE = the project level standard error of the area weighted differences between measured plot observation and predicted values of carbon storage.

N = total number of plot observations in all analysis units 1.654 = the 90% confidence interval t -value

All other terms as defined in equation 60a.

$$SE = S / \sqrt{N} \quad (60d)$$

where:

N = total number of plot observations in all analysis units

S = the standard deviation of the area weighted differences between measured and predicted values of carbon storage across all analysis units.

$$S = \sqrt{[(1/N - 1) \cdot \sum (y_{d,h,i} - \bar{y}_{bar_d})^2]} \quad (60e)$$

where:

$\bar{y}_{bar_d}$ = the project-level mean of the area weighted differences between measured plot observation and predicted values of carbon storage. See equation 60b for the calculation of $y_{d,h,i}$

All other terms as defined in equation 60b and 60c.

Step 3 - The total error for the project (E_P ; %) is calculated by adding the model and inventory error terms, as calculated in Steps 1 and 2.

$$E_P = E_M + E_I \quad (60f)$$

Step 4 - Compare the result of Step 3 against Table 20: Uncertainty Factor calculation. to determine the uncertainty factor.

Table 20: Uncertainty Factor calculation.

Estimated Project Error, E_P (%)	Uncertainty Factor (= $ER_{Y,ERR}$)
0 – 10%	= 1.5%
>10%	= 1.5% + E_P – 10%

6.5.2 Initial Estimate of Uncertainty

Carbon plot volumes were compiled using CBM-CFS3. The inventory error term (E_I) was calculated to be 12.91% while the model error term (E_M) was 14.53%. As shown in Equation 60f, the project error term (E_P) was calculated as the sum of E_M and E_I (27.44%). Thus, the uncertainty factor ($ER_{Y,ERR}$) was calculated (based upon Table 20) to be 18.94%.

This uncertainty factor will be re-assessed at verification and adjusted annually to reflect improved field data from the project monitoring plot network.

6.5.3 Calculation Net Emissions Reductions

Net carbon emissions reductions (ER_y) created by the BigCoast Carbon Project were calculated annually utilizing equation 58:

$$ER_y = ER_{y,GROSS} - LE_y \quad (58)$$

where:

ER_y = the net GHG emissions reductions and/or removals in year y (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) (t CO₂e yr⁻¹).

$ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios ($t\ CO_2e\ yr^{-1}$), as calculated within Section 4.4.1

LE_y = Leakage in year y ($t\ CO_2e\ yr^{-1}$), as described in Section 6.4.2.

6.5.4 Calculation of Voluntary Credit Units (VCUs)

The number of VCU's the BigCoast carbon project generates as available for issuance and sale in year, y (VCU_y ; $t\ CO_2e\ yr^{-1}$), is calculated as:

$$VCU_y = ER_y \cdot (1 - ER_{y,ERR}) - BR_y \quad (59)$$

where:

ER_y = the net GHG emissions reductions and/or removals in year ($t\ CO_2e\ yr^{-1}$), as calculated in equation 58.

$ER_{y,ERR}$ = the uncertainty factor for year, y , (calculated in Section 6.5.2), expressed as a proportion.

BR_y = estimated VCU-equivalent tCO_2e issued to the VCS Buffer Pool in year, y , calculated using the latest version of the VCS Tool for AFOLU Non-Permanence Risk Analysis and Buffer (Voluntary Carbon Standard, 2008).

BR_y is calculated by multiplying the most current verified permanence risk Buffer Withholding Percentage for the project by the change in carbon stocks (difference between baseline and project scenario) for the project area.

The project VCS Buffer Discount Factor (BR_V) was calculated as 18%, as per the non-permanence risk assessment. The BR factor will be re-assessed at each verification, as necessary.

The uncertainty factor was determined to be 1.5%, as calculated above. The uncertainty factor will be re-calculated from field plot data at each verification.

The annual VCUs projected for BigCoast for the verification period of 01-January-2018 to 31-December-2021 are calculated in table 23.

Table 21: Net GHG Emissions Reductions and Removals

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)	Buffer pool allocation	VCUs eligible for Issuance
01-January-2018 – 31-December-2018	-144,512	112,699	0	257,210	46,298	162,197
01-January-2019 – 31-December-2019	-169,923	108,302	0	278,225	50,081	175,449
01-January-2020 – 31-December-2020	-187,347	108,820	0	296,167	53,310	186,763
01-January-2021 – 31-December-2021	-202,166	109,274	0	311,440	56,059	196,394
Total	-703,947	439,095	0.0	1,143,043	205,748	720,803

7 REFERENCES

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APPENDIX 1 – NON-PERMANENCE RISK REPORT

APPENDIX 2 – OUTPUT FROM CBM-CFS3 MODEL RUNS

Time Step	CBM Model Year	Delta Total Ecosystem* (BSL)	Delta Total Ecosystem* (PRJ)
January 1, 2017 - December 31, 2017	1	0	0
January 1, 2018 - December 31, 2018	2	-33,789	30,736
January 1, 2019 - December 31, 2019	3	-40,719	29,537
January 1, 2020 - December 31, 2020	4	-45,471	29,678
January 1, 2021 - December 31, 2021	5	-49,513	29,802
January 1, 2022 - December 31, 2022	6	-122,842	29,891
January 1, 2023 - December 31, 2023	7	-134,763	29,963
January 1, 2024 - December 31, 2024	8	-145,975	28,681
January 1, 2025 - December 31, 2025	9	-154,327	28,789
January 1, 2026 - December 31, 2026	10	-161,295	28,894
January 1, 2027 - December 31, 2027	11	-118,630	28,967
January 1, 2028 - December 31, 2028	12	-117,433	29,031
January 1, 2029 - December 31, 2029	13	-117,764	27,429
January 1, 2030 - December 31, 2030	14	-116,661	27,535
January 1, 2031 - December 31, 2031	15	-115,549	27,650
January 1, 2032 - December 31, 2032	16	-114,396	27,753

Time Step	CBM Model Year	Delta Total Ecosystem* (BSL)	Delta Total Ecosystem* (PRJ)
January 1, 2033 - December 31, 2033	17	-113,812	27,858
January 1, 2034 - December 31, 2034	18	-114,283	26,268
January 1, 2035 - December 31, 2035	19	-113,332	26,335
January 1, 2036 - December 31, 2036	20	-112,228	26,410
January 1, 2037 - December 31, 2037	21	-101,873	26,493
January 1, 2038 - December 31, 2038	22	-99,063	26,562
January 1, 2039 - December 31, 2039	23	-97,491	25,140
January 1, 2040 - December 31, 2040	24	-94,975	25,189
January 1, 2041 - December 31, 2041	25	-92,571	25,238
January 1, 2042 - December 31, 2042	26	-90,465	25,288
January 1, 2043 - December 31, 2043	27	-88,130	25,323
January 1, 2044 - December 31, 2044	28	-86,937	23,939
January 1, 2045 - December 31, 2045	29	-84,908	23,981
January 1, 2046 - December 31, 2046	30	-83,121	24,025
January 1, 2047 - December 31, 2047	31	-19,049	24,067

* For analyses of Total Delta Ecosystem, annual values greater than zero indicate that the ecosystem is functioning as a carbon sink, annual values below zero indicate that it is functioning as a carbon source, and an annual value of exactly zero indicates that the ecosystem is carbon-neutral (i.e., neither a source nor a sink).

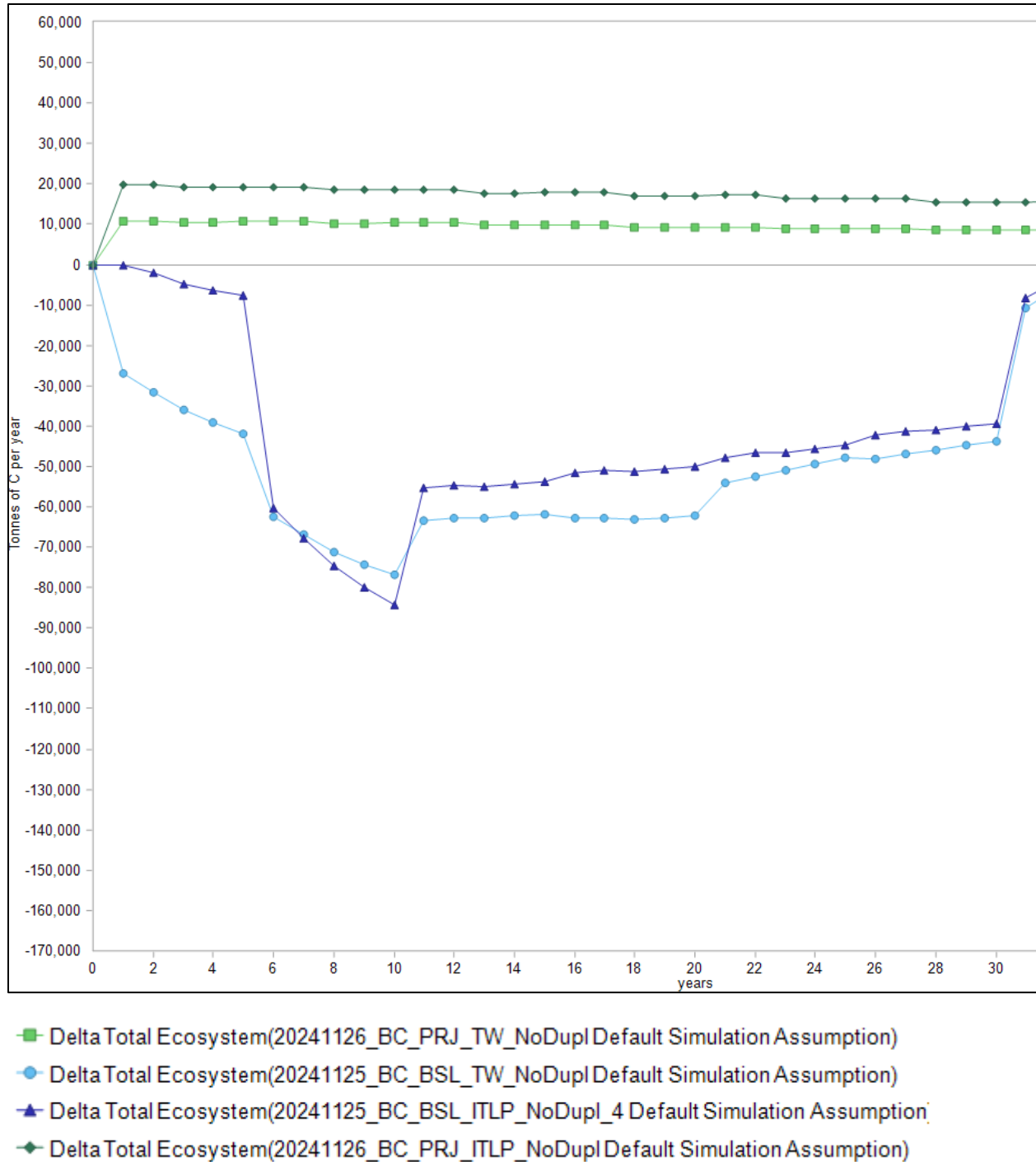


Figure 5: CBM-CFS graphical output of Delta Total Ecosystem between Baseline (blue) and Project (green) scenario (tC). Note: values for each land base for each scenario are added together to obtain yearly total values.

APPENDIX 3 – SUPPORTING DATA FILES

The following table identifies the key data files used for calculating all aspects of the Project Development Document. All additional files not submitted here will be provided to the Auditors upon request.

Table 22: List of reporting document files used in the formation of the BigCoast Project Development Document

Description	Filename	Format	Date
Spatial Inventory data for the BigCoast project	BigCoastProject.gdb	Arc Database	2022-05-22
Carbon TSA/ inventory dataset	AU Areas CarbonProject_Aug1722	Excel	2022-08-17
Woodstock Report Data. Pivot tables used as input for HWP and Emissions	2022 Ecora Woodstock Final PRJ	Excel	2022-05-27
CBM-CFS Stores result and run assumptions along with all carbon pools and fluxes related to the BSL model run	20241125_BC_BSL_TW_NoDupl Default Simulation Assumption Results 20241126_BC_BSL_ITLP_NoDupl_4 Default Simulation Assumption Results	Access Datafile (large)	2024-11-25
CBM-CFS Stores result and run assumptions along with all carbon pools and fluxes related to the PRJ model run	20241125_BC_PRJ_TW_NoDupl Default Simulation Assumption Results 20241126_BC_PRJ_ITLP_NoDupl_4 Default Simulation Assumption Results	Access Datafile (large)	2024-11-26
CBM-CFS Delta Ecosystem Results (BSL and PRJ)	DeltaEco_NoDupl(Nov26'24)	Excel	2024-11-26
CBM disturbances by area (ha)	BC_BSL_areadist	Excel	2022-05-26
Annual Change in carbon storage for wood products in the baseline	Mosaic - BSL HWP (Sept '22)	Excel	2022-09-06

Fossil Fuel emissions related to logging, transport and manufacturing (optional pool)	Emissions_BSL_Estimate (Aug '22)	Excel	2022-08-18
VCU determination worksheet	Final GHG Estimate (Nov 26, 2024)_(2018-2021)_Rev1	Excel	2024-11-26
Calculation of Uncertainty Factor	VM0012 - Uncertainty - NFI (Nov'24)	Excel	2024-11-27
Monitoring plots – compiled merch volume	Input - ZIMFOR_COMP_V3	Excel	2022-05-25
Monitoring plots – compiled CWD volume	Input - CWD_TRANSECT_COMPILER_43PLOTS	Excel	2022-05-22
Activity Shifting Leakage Analysis	BigCoast Activity Shifting Leakage-(Jun '22)	Excel	2022-06-08

APPENDIX 4 – SPATIAL NDVI ANALYSIS

7.1.1 Monitoring – Project Area

The spatial monitoring program was implemented to identify natural disturbance events >4ha, planned project activities such as harvests, road construction and reforestation, and unplanned anthropogenic (“human-caused”) disturbances such as illegal or unplanned harvests.

Changes in vegetation cover were monitored by comparing temporally distinct satellite images and their respective derived Normalized Difference Vegetation Indices (NDVI). The resulting analysis calculates either an increases or decreases in vegetation cover which can be classified and symbolized according to the magnitude of change. Changes are measured at the pixel scale of the imagery (20m x 20m for *Sentinel-2 2LA* imagery).

Losses of at least 0.5ha in area (12 continuous pixels) where assigned a Poly ID, further examined to categorize the change/ loss as cloud cover-water reflection, natural disturbance, planned project activities or unplanned harvests.

7.1.2 Data Acquisition

To account for seasonality of vegetation cover, satellite imagery from 2020 and 2021 within a close seasonal range were selected for comparison analysis. Cloud cover was limited to between 0 and 3%, but not entirely avoidable due to the large project area coverage, the variability of timing for satellite flight paths, and days of data availability.

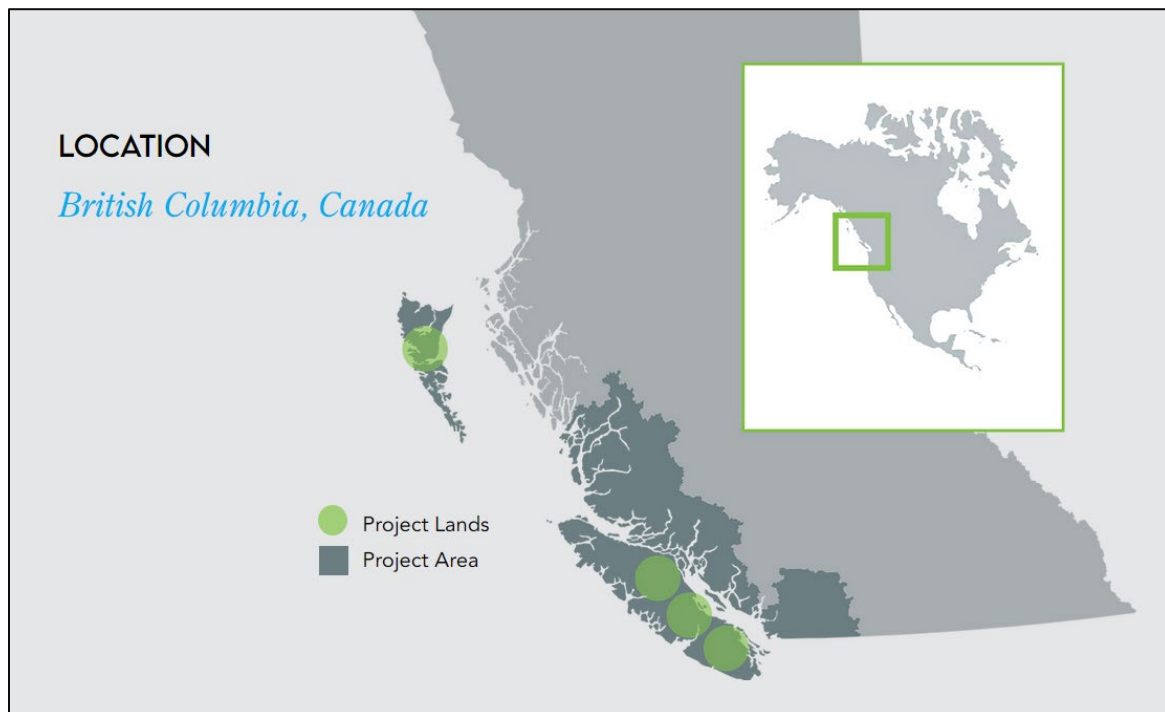


Figure A1: Project Area Coverage

7.1.3 Data Classification

Representative ranges were established for the change in NDVI over the designated time period.

Table A1: Classification Ranges for Changes in NDVI

NDVI change	Qualitative Classification
> 0.2	Significant vegetation gain
0.1 to 0.2	Vegetation gain
0.05 to 0.1	Minor vegetation gain
0 to 0.05	Minimal positive vegetation change
0 to -0.05	Minimal negative vegetation change
-0.05 to -0.1	Minor vegetation loss
-0.1 to -0.2	Vegetation loss
< -0.2	Significant vegetation loss

7.1.4 Results

The project area is non-contiguous and encompasses the West and South Coast of B.C with the PAI located throughout Vancouver Island, Cortes Island, and Haida Gwaii.

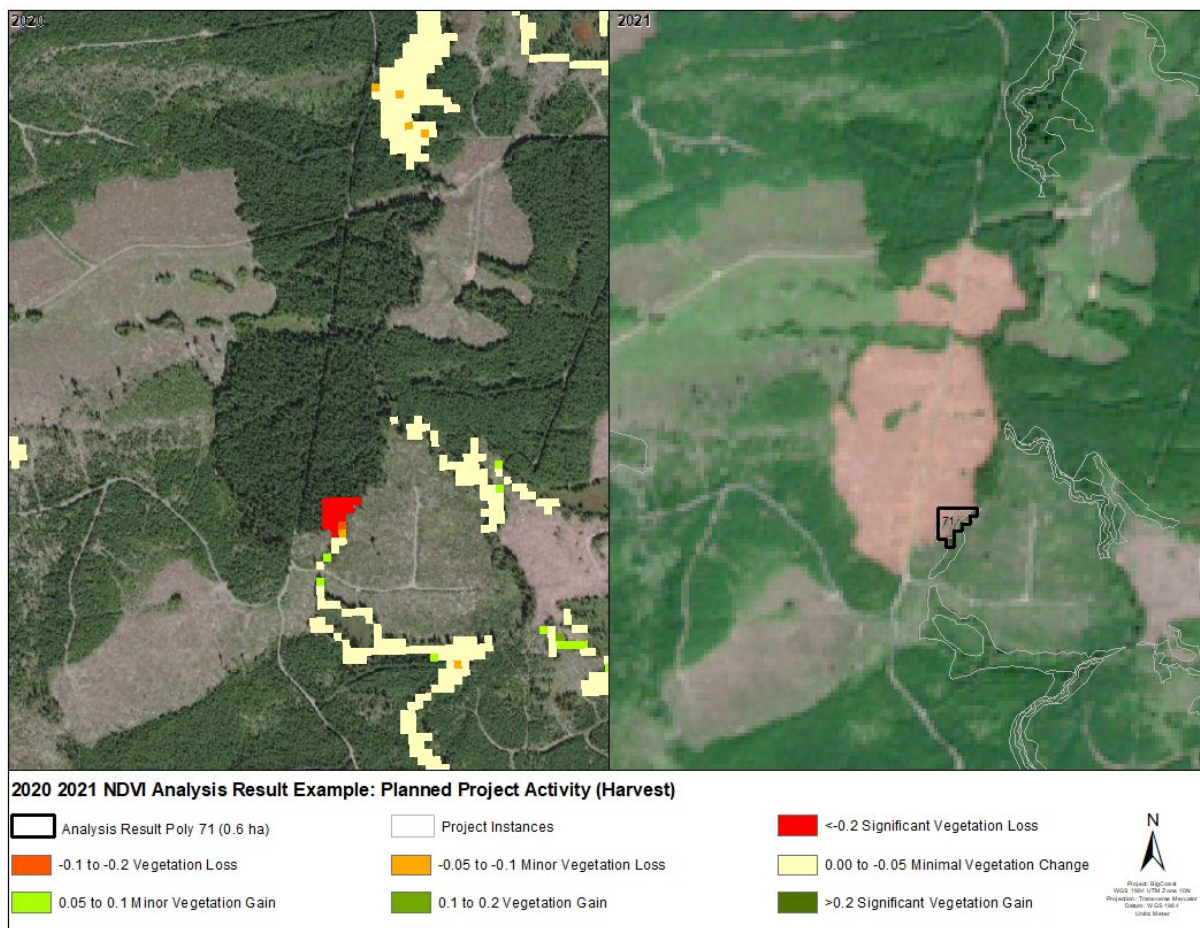
No natural, planned, or unplanned disturbance events resulting in vegetation losses >0.5 ha were observed in the Haida Gwaii area.

Spatial change detection in the PAI on Vancouver Island resulted in nine areas where vegetation losses were greater than 0.5ha was confirmed (Table A2 below).

All losses can be attributed to unplanned operational activities within the PAI. These were small non-contiguous areas that were incidentally affected by adjacent harvesting due to the nature of the project design. The total loss accounts for a 0.02% change over the PAI, which is considered *de-minimus*. Area changes will be captured, classified, and updated in the Project Proponent's 2022 forest inventory and TSA update. The figure below is an example of vegetation change in poly ID 71.

Table A2: NDVI areas with significant loss of vegetation encompassing >0.5 ha

Poly ID	Area(ha)	Disturbance Type
55	0.88	Unplanned
57	0.68	Unplanned
66	2.29	Unplanned
71	0.55	Unplanned
75	1.33	Unplanned
85	2.69	Unplanned
93	0.75	Unplanned
97	0.67	Unplanned
101	0.86	Unplanned


Figure A2: Area with significant loss in vegetation cover >0.5ha (Poly ID 71)

7.1.5 Discussion

Forest inventory revisions on Project Proponent lands are conducted yearly (at a minimum) as per the Forest Inventory Standard. Inventory information is collected through numerous models, reports, geospatial analysis, field surveys, and stored in both spatial and aspatial databases. The intent is to model and grow future stands, as well as use best forest management practices for operational activities on stands using current data.

Due to the complex and ever-changing nature of managing a large and diverse land base, and information being stored in independent databases, updates are not immediate and tend to have a reporting lag time. The data used for this project (TSA Dataset 2021) reflects all disturbances up to January 1, 2021. The unplanned disturbance events are considered minimal, will be reflected as harvested area in Project Proponent's data management systems and processes are in place to ensure updates are made. Significant vegetation loss events will be monitored and reported at each verification period.

7.1.6 Conclusion

No natural or planned disturbances were identified within the project area, and nine areas of unplanned harvests were noted within the PAI on Vancouver Island only. These areas captured *de-minimus* vegetation loss in 2021 and will be updated in Project Proponent's forest inventory database in 2022. The next monitoring period will identify any substantial impacts to carbon stocks and account for any changes in the *ex-post* calculations.

The completion of the NDVI spatial assessment between years 2020 and 2021 indicates that no additional changes/ updates are required for analysis units utilized in calculating carbon stocks.

APPENDIX 5 - VM0012 EQUATIONS

Methodology Section #	Equation #	Screenshot
8.1.2	1	The total annual carbon balance in year, t, for the baseline scenario is calculated as ($\Delta C_{BSL,t}$, in t C yr⁻¹): $\Delta C_{BSL,t} = \Delta C_{BSL,P,t} \quad (1)$ where: $\Delta C_{BSL,P,t}$ = annual change in carbon stocks in all pools in the baseline across the project activity area; t C yr⁻¹.
8.1.2	2	$\Delta C_{BSL,P,t} = \Delta C_{BSL,LB,t} + \Delta C_{BSL,DOM,t} + \Delta C_{BSI,HWP,t} \quad (2)$ where: $\Delta C_{BSL,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr⁻¹ $\Delta C_{BSL,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr⁻¹ $\Delta C_{BSI,HWP,t}$ = annual change in carbon stocks associated with harvested wood products, t C yr⁻¹.
8.1.2	3	$\Delta C_{BSL,LB,t} = \Delta C_{BSL,G,t} - \Delta C_{BSL,L,t} \quad (3)$ where: $\Delta C_{BSL,G,t}$ = annual increase in tree carbon stock from growth; t C yr⁻¹ $\Delta C_{BSL,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr⁻¹. <i>If the project area has been stratified, carbon pools are calculated for each polygon, i, and then summed during a given year, t.</i>

Methodology Section #	Equation #	Screenshot
8.1.3	4	Live biomass gain in year, t, polygon, i ($\Delta C_{BSL,G,i,t}$) is calculated as: $\Delta C_{BSL,G,i,t} = \Sigma(A_{BSL,i} \bullet G_{BSL,i,t}) \bullet CF \quad (4)$ where: $A_{BSL,i}$ = area (ha) of forest land in polygon, i; $G_{BSL,i,t}$ = annual increment rate in tree biomass ($t \text{ d.m. ha}^{-1} \text{ yr}^{-1}$), in polygon, i, and; CF = carbon fraction of dry matter $t \text{ C t}^{-1} \text{ d.m.}$ (IPCC default value = 0.5).
8.1.3	5a	$G_{BSL,i,t} = G_{BSL,AG,i,t} + G_{BSL,BG,i,t} \quad (5a)$ where: $G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above- and belowground biomass increment rates ($t \text{ d.m. ha}^{-1} \text{ yr}^{-1}$);
8.1.3	5b	$G_{BSL,AG,i,t}$ and $G_{BSL,BG,i,t}$ = annual above- and belowground biomass increment rates ($t \text{ d.m. ha}^{-1} \text{ yr}^{-1}$); $G_{BSL,BG,i,t} = G_{BSL,AG,i,t} \bullet R_i \quad (5b)$ where R_i is the root:shoot ratio in polygon, i. R_i should ideally be estimated for each polygon, but these data are difficult to derive empirically. Hence, general relationships are acceptable as long as they are appropriate for the species and region associated with the project (Cairns, 1997). Equations 4 and 5 can be used directly to calculate $\Delta C_{BSL,G,i,t}$ when all tree cover within a polygon is removed by harvesting (i.e., clearfelling) and no residual structure is retained. In cases of partial harvesting and/or multiple entries into a polygon, these equations must be applied separately to each of the resulting sub-polygons (the different age classes that are created). This ensures that growth rates reflect the difference in forest age between the sub-polygons. The ex ante calculation of $G_{BSL,i,t}$ (either directly, or from its component parts) will be derived from models that require inputs derived, in part, from forest inventory data. Criteria for model suitability are provided in 8.1.1.1. The exact form of the input data depends on the nature of the model but may include site index, species composition, and volume.

Methodology Section #	Equation #	Screenshot
8.1.4	6	$\Delta C_{BSL,L,t} = \Sigma(LBL_{BSL,NATURAL,i,t} + LBL_{BSL,FELLINGS,i,t} + LBL_{BSL,OTHER,i,t}) \bullet CF \quad (6)$ where: $LBL_{BSL,NATURAL,i,t}$ = annual loss of live tree biomass due to natural mortality in polygon, i; t d.m. yr⁻¹ $LBL_{BSL,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, i; t d.m. yr⁻¹ $LBL_{BSL,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, i; t d.m. yr⁻¹ CF = carbon fraction of dry matter; t C t⁻¹ d.m. (IPCC default value = 0.5).
8.1.4	7 ¹⁸	$LBL_{BSL,NATURAL,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,NATURAL,i,t} \quad (7)^{18}$ where $A_{BSL,i}$ = area (ha) of forest land in polygon, i; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t $LB_{BSL,i,t}$ is calculated for year, t, beginning with biomass estimates in year $t=1$ (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5a. $f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; $0 \leq f_{BSL,NATURAL,i,t} \leq 1$), year, t. Tree mortality is an ongoing process during stand development. Trees die as a consequence of insect attack, disease, competition, or some combination thereof. Hence, mortality can be highly variable between years. This parameter can be applied uniformly across an analysis unit, or individually to a given polygon. Sources for mortality estimates include permanent sample plots in similar stand types, literature reports, and inventory data.

Methodology Section #	Equation #	Screenshot
8.1.4	8	$LBL_{FELLINGS,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,HARVEST,i,t}$ (8) where: $A_{BSL,i}$ = area (ha) of forest land in polygon, i $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t (see equation 7 for its calculation). $f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 \leq f_{BSL,HARVEST,i,t} \leq 1$), in year, t. Data for this variable should be obtained from harvest schedule information. Values may be constrained by (a) the value of $f_{BSL,NATURAL,i,t}$ (i.e., $f_{BSL,HARVEST,i,t} < 1 - f_{BSL,NATURAL,i,t}$), and/or (b) the area of timber available for commercial harvest. Incidental loss ($LBL_{BSL,OTHER,i,t}$; t d.m. yr⁻¹) is the additional live tree biomass removed for road and landing construction in the polygon, i, and is calculated as a proportion of biomass removed by harvesting:
8.1.4	9	$LBL_{BSL,OTHER,i,t} = A_{BSL,i} \bullet LB_{BSL,i,t} \bullet f_{BSL,DAMAGE,i,t}$ (9) where: $A_{BSL,i}$ = area (ha) of forest land in polygon, i; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, i, year, t (unitless; $0 \leq f_{BSL,DAMAGE,i,t} \leq 1$)¹⁹. Data for this variable should be based on regional and local comparative studies and experiential information derived from the local forest industry²⁰.
8.1.5	10	The annual change in carbon stocks in DOM ($\Delta C_{BSL,DOM}$; t C yr⁻¹) is calculated as: $\Delta C_{BSL,DOM,t} = \Delta C_{BSL,LDW,t} + \Delta C_{BSL,SNAG,t} + \Delta C_{BSL,DBG,t}$ (10)

Methodology Section #	Equation #	Screenshot
		where: $\Delta C_{BSL,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; $t \text{ C yr}^{-1}$ $\Delta C_{BSL,SNAG,t}$ = change in snag carbon stock in year, t; $t \text{ C yr}^{-1}$ $\Delta C_{BSL,DBG,t}$ = change in dead belowground biomass carbon stock in year, t; $t \text{ C yr}^{-1}$.
8.1.5	11a	$\Delta C_{BSL,LDW,t} = \Sigma(LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t}) \bullet CF \quad (11a)$
8.1.5	11b	$LDW_{BSL,i,t+1} = LDW_{BSL,i,t} + (LDW_{BSL,IN,i,t} - LDW_{BSL,OUT,i,t}) \quad (11b)$ where: $LDW_{BSL,i,t}$ = The total mass of lying dead wood accumulated in polygon i, at time, t (t d.m.). $LDW_{BSL,IN,i,t}$ = annual increase in LDW biomass for polygon i, year, t (t d.m. yr^{-1}). LDW increases occur as a result of natural mortality (typically, blowdown), and as a direct or indirect result of harvesting. $LDW_{BSL,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon i, year, t, (t d.m. yr^{-1}) $LDW_{BSL,IN,i,t}$ and $LDW_{BSL,OUT,i,t}$ are summed across polygons. CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.1.5	12	$ \begin{aligned} LDW_{BSL,IN,i,t} = & (LBL_{BSL,NATURAL,i,t} - LBL_{BSL,NATURAL,i,t} \bullet R_i) \bullet f_{BSL,BLOWDOWN,i,t} + \\ & ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + \\ & (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet f_{BSL,BRANCH,i,t} + \\ & ((LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i) + \\ & (LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i)) \bullet \\ & (1 - f_{BSL,BRANCH,i,t}) \bullet f_{BSL,BUCKINGLOSS,i,t} + SNAG_{BSL,i,t} \bullet f_{BSL,SNAGFALLDOWN,i,t} \quad (12) \end{aligned} $ where: $LBL_{BSL,NATURAL,i,t}$, $LBL_{BSL,FELLINGS,i,t}$, and $LBL_{BSL,OTHER,i,t}$ are as calculated in equations 7, 8, and 9, respectively. R_i is the root:shoot ratio in polygon, i (see equation 5b). $f_{BSL,BLOWDOWN,i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t (unitless; $0 \leq f_{BSL,BLOWDOWN,i,t} \leq 1$). Ex ante estimates must be derived preferably from regional reports in similar forest types. $f_{BSL,BRANCH,i,t}$ = the annual proportion of aboveground tree biomass comprised of branches ≥ 5 cm diameter in polygon, i (unitless; $0 \leq f_{BSL,BRANCH,i,t} \leq 1$). Ex ante data are available from allometric equations and models (for example, (Kurz & Apps, 2006) for Canada; (Smith, Miles, Vissage, & Pugh, 2004) for the U.S.). In the event slash burning was undertaken as part of regular management activities, this parameter should be reduced accordingly to reflect the proportion of biomass remaining. Estimates should be obtained from expert opinion; as a default, assume 100% consumption if slash burning occurs.

Methodology Section #	Equation #	Screenshot
		$f_{BSL, BUCKINGLOSS, i, t}$ = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i (unitless; $0 \leq f_{BSL, BUCKINGLOSS, i, t} \leq 1$). Preferably, data for this variable must be based on regional and local comparative studies and experiential information derived from the local forest industry. Otherwise, an average default value of 21% can be used, based on US national summary statistics (Smith, Miles, Vissage, & Pugh, 2004). $SNAG_{BSL, i, t}$ = the total mass of the snag pool in polygon, i, year, t (see equation 14b). $f_{BSL, SNAGFALLDOWN, i, t}$ = the annual proportion of snag biomass in polygon, i, year, t, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{SNAGFALLDOWN, i, t} \leq 1$). Ex ante estimates for this parameter can be derived from peer reviewed literature (for example, (Parish, Antos, Ott, & Di Lucca, 2010) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools (for example, (Kurz & et al, 2009).
8.1.5	13	$LDW_{BSL, OUT, i, t} = LDW_{BSL, i, t} \bullet f_{BSL, LDWDECAY, i, t}$ (13) where: $LDW_{BSL, i, t}$ = the total amount of lying deadwood mass in polygon i, year, t (see equation 11b). $f_{BSL, LDWDECAY, i, t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon i, year, t (unitless; $0 \leq f_{BSL, LDWDECAY, i, t} \leq 1$). A common approach to ex ante estimation of $f_{BSL, LDWDECAY, i, t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with a single exponential model, of the general form: $Y_t = Y_0 e^{-kt}$ where Y_0 is the initial quantity of material, Y_t the amount left at time t, and k is a decay constant (Harmon, et al., 1986). Other types of exponential models are available (reviewed in (Harmon, et al., 1986)) and may be more appropriate to particular forest types (to be described and justified by the project proponent, if used). Ex ante estimates for the decay parameter appropriate for the project should be derived from peer-reviewed literature (for example, (Harmon, et al., 1986); (Laiho & and Prescott, 2004); (Harmon et al, 2008)).
8.1.5	14a	The change in standing dead wood (snag) carbon stock in year, t ($t \text{ C yr}^{-1}$) is calculated as: $\Delta C_{BSL, SNAG, t} = \Sigma(SNAG_{BSL, IN, i, t} - SNAG_{BSL, OUT, i, t}) \bullet CF$ (14a)

Methodology Section #	Equation #	Screenshot
8.1.5	14b	$SNAG_{BSL,i,t+1} = SNAG_{BSL,i,t} + (SNAG_{BSL,IN,i,t} - SNAG_{BSL,OUT,i,t})$ (14b) where: $SNAG_{BSL,i,t}$ = The total mass of snags accumulated in polygon i, at time t (t d.m.). $SNAG_{BSL,IN,i,t}$ = annual gain in snag biomass for polygon i, year, t (t d.m yr⁻¹). Snag biomass develops as a result of natural mortality. In cases where snags are created through management activities, these should be accounted for here. $SNAG_{BSL,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m yr⁻¹) CF = carbon fraction of dry matter (IPCC default value = 0.5). Note that $SNAG_{BSL,IN,i,t}$ and $SNAG_{BSL,OUT,i,t}$ are summed across polygons.
8.1.5	15	$SNAG_{BSL,IN,i,t} = (LBL_{BSL,NATURALi,t} - LBL_{BSL,NATURALi,t} \bullet R_i) \bullet (1 - f_{BSL,BLOWDOWN,i,t})$ (15) where: $LBL_{BSL,NATURALi,t}$ is as calculated in equation 7, and $1 - f_{BSL,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, i, year, t, but remains as standing dead organic matter (i.e., snags) (unitless; $0 \leq f_{BSL,BLOWDOWN,i,t} \leq 1$). Ex ante default estimates for this calculation can be derived from literature values (for example (Harmon, et al., 1986); (Runkle, 2000); (Harmon et al, 2008)) and should be matched to the ecosystems that most closely characterize the project area.

Methodology Section #	Equation #	Screenshot
8.1.5	16	$SNAG_{BSL,OUT,i,t} = SNAG_{BSL,i,t} \cdot f_{BSL,SWDECAY,i,t} + SNAG_{BSL,i,t} \cdot f_{BSL,SNAGFALLDOWN,i,t}$ (16) where: $SNAG_{BSL,i,t}$ = the total amount of snag mass in polygon i, year, t (see equation 14b). $f_{BSL,SWDECAY,i,t}$ = the annual proportional loss of snag biomass due to decay, in polygon, i, year, t (unitless; $0 \leq f_{BSL,SWDECAY,i,t} \leq 1$). As with lying dead wood, a common approach to estimating $f_{BSL,SWDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with a single exponential model (see equation 13). Ex ante estimates for this parameter should be derived from peer reviewed literature appropriate for the project site (for example, Vanderwel et al. 2006a) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools for each forest type, productivity, and age-class (see, for example, Vanderwel et al., 2006b; Kurz & et al, 2009)). $f_{BSL,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, i, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{BSL,SNAGFALLDOWN,i,t} \leq 1$). See equation 12 for parameter estimates. The annual change in DOM derived from dead belowground biomass ($\Delta C_{BSL,DBG,i,t}$; t C yr⁻¹) is calculated for each polygon as per equation 17a. Calculation of $\Delta C_{BSL,DBG,i,t}$ is specific to a given polygon; each polygon must therefore be summed in order to calculate total annual loss across the project activity area.
8.1.5	17a	$\Delta C_{BSL,DBG,t} = \Sigma(DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t}) \cdot CF$ (17a)
8.1.5	17b	$DBG_{BSL,i,t+1} = DBG_{BSL,i,t} + (DBG_{BSL,IN,i,t} - DBG_{BSL,OUT,i,t})$ (17b) where: $DBG_{BSL,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon i, at time, t (t d.m.). $DBG_{BSL,IN,i,t}$ = annual gain in dead belowground biomass for polygon i, year, t (t d.m yr⁻¹). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities. $DBG_{BSL,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m yr⁻¹) CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.1.5	17c	$DBG_{BSL,IN,i,t} = [(A_{BSL,i} \bullet LB_{BSL,i,t} \bullet R_i) \bullet (f_{BSL,NATURAL,i,t} + f_{BSL,HARVEST,i,t} + f_{BSL,DAMAGE,i,t})]$ (17c) where: $A_{BSL,i}$ = area (ha) of forest land in polygon, i; $LB_{BSL,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t. $LB_{BSL,i,t}$ is calculated for year, t, beginning with biomass estimates in year $t=1$ (the project start year) and with annual biomass increments ($G_{BSL,i,t}$) added as per calculations in equation 5 a, b. This value is then multiplied by $A_{BSL,i}$, the area (ha) of forest land in polygon, i. R_i is the root:shoot ratio in polygon, i (see equation 5b). $f_{BSL,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; $0 \leq f_{NATURAL,i,t} \leq 1$), year, t (see equation 7), $f_{BSL,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 \leq f_{HARVEST,i,t} \leq 1$), year, t (see equation 8), $f_{BSL,DAMAGE,i,t}$ = the proportion of additional biomass removed or road and landing construction in polygon, i (unitless; $0 \leq f_{DAMAGE,i,t} \leq 1$), year, t (see equation 9)
8.1.5	17d	$DBG_{BSL,OUT,i,t} = DBG_{BSL,i,t} \bullet f_{BSL,dgbDECAY,i,t}$ (17d) where: $DBG_{BSL,i,t}$ = the total quantity of dead belowground in polygon i, year, t (see equation 17b). $f_{BSL,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon i, year, t (unitless; $0 \leq f_{BSL,dgbDECAY,i,t} \leq 1$). The ex ante estimation of the decay of dead belowground biomass should be done using a similar single exponent decay function as that described above for lying deadwood biomass. Estimates for the decay parameter appropriate for specific project should be derived from peer-reviewed literature (see for example: (Moore, Trofymow, Siltanen, Prescott, & CIDET, 2005)); Melin et al. (2009); (Melin, Petersson, & Nordfjell, 2009)).

Methodology Section #	Equation #	Screenshot
8.1.6	18	The annual change emissions associated with the production of harvested wood products (HWP), $\Delta C_{BSL,HWP,t}$, is calculated as: $\Delta C_{BSL,HWP,t} = \Delta C_{BSL,STORHWP,t} - \Delta C_{BSL,EMITFOSSIL,t} \quad (18)$ $\Delta C_{BSL,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products (t C yr⁻¹) $\Delta C_{BSL,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.
8.1.7	19	The annual change in carbon storage in harvested wood products in year t ($\Delta C_{BSL,STORHWP,t}$; t C yr⁻¹) is determined based upon the following equation: $\Delta C_{BSL,STORHWP,t} = (C_{BSL,STORHWP,t2} - C_{BSL,STORHWP,t1}) / T \quad (19)$ where: $C_{BSL,STORHWP,t2}$ = carbon storage in harvested wood products at $t=2$; t C $C_{BSL,STORHWP,t1}$ = carbon storage in harvested wood products at $t=1$; t C T = number of years between monitoring $t1$ and $t2$ t : 1,2,3...t years elapsed since the project start date

Methodology Section #	Equation #	Screenshot
8.1.7	20	$C_{BSL,TIMBER,h} = \Sigma[(LBL_{BSL,FELLINGS,i,h} - LBL_{BSL,FELLINGS,i,h} \bullet R_i + LBL_{BSL,OTHER,i,h} - LBL_{BSL,OTHER,i,h} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,h}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,h})] \bullet CF \quad (20)$ where: $C_{BSL,TIMBER,h}$ = carbon contained in timber harvested in period h (summed for all harvested polygons, i); t C $LBL_{BSL,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, i; t d.m. (equation 8) $LBL_{BSL,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. (equation 9) R_i is the root:shoot ratio in polygon, i (see equation 5b). $1 - f_{BSL,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon i (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$) (see equation 12) $1 - f_{BSL,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, i (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 12) h = harvest period ; yr
8.1.7	21	$C_{BSL,MILL,h,k} = (C_{BSL,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k}) \quad (21)$

Methodology Section #	Equation #	Screenshot
		where: $C_{BSL_MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type k; t C $C_{BSL_TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type k; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) $f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type k (default values by region in Table 1.5 of the 1605(b) document); dimensionless $r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type k (default values by region in Table 1.5 of the 1605(b) document); dimensionless
8.1.7	22a	Three values are then calculated from these data selected from Table 1.6 in the 1605(b) document, for each product type, k : the short-lived fraction ($P_{BSL_SLF,k}$), medium-lived fraction ($P_{BSL_MLF,k}$), and long-lived fraction ($P_{BSL_LLF,k}$): $P_{BSL_SLF,k} = 1 - P_{3\text{-year}} \quad (22a)$
8.1.7	22b	$P_{BSL_LLF,k} = P_{100\text{-year}} \quad (22b)$
8.1.7	22c	$P_{BSL_MLF,k} = P_{3\text{-year}} - P_{100\text{-year}} , \quad (22c)$

Methodology Section #	Equation #	Screenshot
8.1.7	23	$C_{BSL,STORHWP,t} = \sum \sum ((C_{BSL,MILL,h,k} \bullet P_{LLF,k}) + [(C_{BSL,MILL,h,k} \bullet P_{MLF,k}) \bullet ((20-h) / 20)]) \quad (23)$ where: $C_{BSL,STORHWP,t}$ = carbon stored in harvested wood products in year t summed for all product types k and then over all harvest periods h; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) h = year of harvest (the term $(20-h)$ should not be allowed to drop below 0)
8.1.8	24	The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{BSL,EMITFOSSIL,t}$) are calculated as: $C_{BSL,EMITFOSSIL,t} = C_{BSL,EMITHARVEST,t} + C_{BSL,EMITMANUFACTURE,t} + C_{BSL,EMITTRANSPORT,t} \quad (24)$ where: $C_{BSL,EMITHARVEST,t}$ is the annual fossil fuel emissions associated with harvesting of raw material (t C yr⁻¹) $C_{BSL,EMITMANUFACTURE,t}$ is the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr⁻¹) $C_{BSL,EMITTRANSPORT,t}$ is the annual fossil fuel emissions associated with the transport of raw material (t C yr⁻¹)

Methodology Section #	Equation #	Screenshot
8.1.8	25	The simplest approach to calculating $C_{BSL,EMITFOSSIL,t}$ is to use published or derived carbon emission intensity factors. In the case of harvesting, $BSL, C_{EMITHARVEST,t}$ ($t\ C\ yr^{-1}$), can be calculated (summed across harvested polygons) as: $C_{BSL,EMITHARVEST,t} = \sum [(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet C_{HARVEST} \quad (25)$ where: $C_{HARVEST}$ is the carbon emission intensity factor ($t\ C\ emitted/t\ C\ raw\ material$) associated with harvesting (see Table 4 for default values); all other terms are as defined in equation 20.
8.1.8	26	$C_{BSL,EMITTRANSPORT,t}$ must be calculated after consideration of the transport distance from harvest to processing facility, and the means of transportation. This term can be calculated as follows (after (Heath, et al., 2010)): $C_{BSL,EMITTRANSPORT,t} = \sum [(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet CF \bullet \sum (f_{BSL,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet C_{TRANSPORTk}) \quad (26)$ where: $f_{BSL,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; $0 \leq f_{BSL,TRANSPORTk} < 1$). $d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); $C_{TRANSPORTk}$ is the carbon emission intensity factor ($kg\ C\ emitted/t\ C\ raw\ material$) associated with transportation type, k (see Table 4 for default values); all other terms are as defined in equation 20.

Methodology Section #	Equation #	Screenshot
8.1.8	27	$C_{BSL,EMITMANUFACTURE,t} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \bullet R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,OTHER,i,t} \bullet R_i) \bullet (1 - f_{BSL,BRANCH,i,t}) \bullet (1 - f_{BSL,BUCKINGLOSS,i,t})] \bullet \Sigma(f_{BSL,PRODUCTk} \bullet C_{MANUFACTUREk}) \bullet CF \quad (27)$ $C_{MANUFACTUREk}$ is the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k; all other terms are as defined in equation 19.
8.2.3	28a	Actual (ex post) annual net carbon stocks are calculated using the equations in this section. $C_{ACTUAL,i,t} = C_{LB,i,t} + C_{DOM,i,t} \quad (28a)$ where: $C_{ACTUAL,i,t}$ = carbon stocks in all selected carbon pools in polygon, i, year, t; t C $C_{LB,i,t}$ = carbon stocks in living tree biomass in polygon, i, year, t; t C $C_{DOM,i,t}$ = carbon stocks in dead organic matter in year, t; t C
8.2.3	28b	$B_{TOTAL,i,t} = (B_{AG,i,t} + B_{BG,i,t}) \quad (28b)$

Methodology Section #	Equation #	Screenshot
8.2.3	28c	$C_{LB,i,t} = (B_{TOTAL,i,t}) \bullet CF$ (28c) where: $B_{AG,i,t}$ = aboveground tree biomass (t d.m. ha⁻¹) measured in polygon, <i>i</i>, year, <i>t</i> $B_{BG,i,t}$ = belowground tree biomass (t d.m. ha⁻¹) measured in polygon, <i>i</i>, year, <i>t</i>. $B_{TOTAL,i,t}$ = total tree biomass (t d.m. ha⁻¹) measured in polygon, <i>i</i>, year, <i>t</i>
8.2.3	28e	$C_{DOM,i,t} = (DOM_{LDW,i,t} + DOM_{SNAG,i,t}) \bullet CF$ (28e) where: $DOM_{LDW,i,t}$ = average mass of dead organic matter contained in lying dead wood (t d.m. ha⁻¹) in measured in polygon, <i>i</i>, year, <i>t</i> $DOM_{SNAG,i,t}$ = average mass of dead organic matter contained in standing snags (t d.m. ha⁻¹) in measured in polygon, <i>i</i>, year, <i>t</i> The average quantity of dead organic matter contained in lying dead wood for measured polygon, <i>i</i>, in year, <i>t</i> ($DOM_{LDW,i,t}$) is calculated according to equations 60a-c in Section 9.3.2. The value of $DOM_{LDW,i,t}$ must be compared to the equivalent calculation of lying dead wood mass ($LDW_{PRJ,i,t}$) in the project scenario (Section 8.2.8) (see comparison method and steps below).
8.2.5	29	The total annual carbon balance in year, <i>t</i>, for the project scenario is calculated as ($\Delta C_{PRJ,t}$, in t C yr⁻¹): $\Delta C_{PRJ,t} = \Delta C_{PRJ,P,t}$ (29) where: $\Delta C_{PRJ,P,t}$ is the annual change in carbon stocks in all pools in the project across the project activity area; t C yr⁻¹.

Methodology Section #	Equation #	Screenshot
8.2.5	30	$\Delta C_{PRJ,P,t} = \Delta C_{PRJ,LB,t} + \Delta C_{PRJ,DOM,t} + \Delta C_{PRJ,HWP,t} \quad (30)$ $\Delta C_{PRJ,LB,t}$ = annual change in carbon stocks in living tree biomass (above- and belowground); t C yr⁻¹ $\Delta C_{PRJ,DOM,t}$ = annual change in carbon stocks in dead organic matter; t C yr⁻¹ $\Delta C_{PRJ,HWP,t}$ is the annual change in carbon stocks associated with harvested wood products, t C yr⁻¹.
8.2.5	31	$\Delta C_{PRJ,LB,t} = \Delta C_{PRJ,G,t} - \Delta C_{PRJ,L,t} \quad (31)$ where: $\Delta C_{PRJ,G,t}$ = annual increase in tree carbon stock from growth; t C yr⁻¹ $\Delta C_{PRJ,L,t}$ = annual decrease in tree carbon stock from a reduction in live biomass; t C yr⁻¹.
8.2.6	32	Live biomass gain in year, t, polygon, i ($\Delta C_{PRJ,G,i,t}$) is calculated as: $\Delta C_{PRJ,G,t} = \Sigma(A_{PRJ,i} \bullet G_{PRJ,i,t}) \bullet CF \quad (32)$ where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, i; $G_{PRJ,i,t}$ = annual increment rate in tree biomass (t d.m. ha⁻¹ yr⁻¹), in polygon, i, and; CF = carbon fraction of dry matter t C t⁻¹ d.m. (IPCC default value = 0.5).
8.2.6	33a	$G_{PRJ,i,t} = G_{PRJ,AG,i,t} + G_{PRJ,BG,i,t} \quad (33a)$ where $G_{PRJ,AG,i,t}$ and $G_{PRJ,BG,i,t}$ are the annual above- and belowground biomass increment rates (t d.m. ha⁻¹ yr⁻¹);

Methodology Section #	Equation #	Screenshot
8.2.6	33b	$G_{PRJ,BG,i,t} = G_{PRJ,AG,i,t} \bullet R_i \quad (33b)$ where R_i is the root:shoot ratio in polygon, i. R_i should ideally be estimated for each polygon, but these data are difficult to derive empirically. Hence, general relationships are acceptable (Cairns, 1997).
8.2.7	34	$\Delta C_{PRJ,L,t} = \Sigma(LBL_{PRJ,NATURALi,t} + LBL_{PRJ,FELLINGS,i,t} + LBL_{PRJ,OTHERi,t}) \bullet CF \quad (34)$ where: $LBL_{PRJ,NATURALi,t}$ = annual loss of live tree biomass due to natural mortality in polygon, i; t d.m. yr⁻¹ $LBL_{PRJ,FELLINGS,i,t}$ = annual loss of live tree biomass due to commercial felling in polygon, i; t d.m. yr⁻¹ $LBL_{PRJ,OTHER,i,t}$ = annual loss of live tree biomass from incidental sources in polygon, i; t d.m. yr⁻¹ CF = carbon fraction of dry matter; t C t⁻¹ d.m. (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.2.7	35 ²⁴	$LBL_{PRJ,NATURAL,i,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,NATURAL,i,t}$ (35)²⁴ where $A_{PRJ,i}$ = area (ha) of forest land in polygon, i; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t $LB_{PRJ,i,t}$ is calculated for year, t, beginning with biomass estimates in year $t=1$ (the project start year) and with annual biomass increments ($G_{PRJ,i,t}$) added as per calculations in equation 33a. $f_{PRJ,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in forest type, i (unitless; $0 \leq f_{PRJ,NATURAL,i,t} \leq 1$), year, t. Tree mortality is an ongoing process during stand development. Trees die as a consequence of insect attack, disease, competition, or some combination thereof. Hence, mortality can be highly variable between years. This parameter can be applied uniformly across an analysis unit, or individually to a given polygon. Ex post estimates from regional data sources in corresponding stand types are preferred. Sources for mortality estimates include permanent sample plots in similar stand types, literature reports, and inventory data. Some models (the FORECAST model, for example) simulate annual background mortality rates directly and can accommodate variable age structures following partial harvesting.
8.2.7	36	$LBL_{PRJ,FELLINGS,i,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,HARVEST,i,t}$ (36) where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, i $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t (see equation 7 for its calculation). $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 \leq f_{PRJ,HARVEST,i,t} \leq 1$), in year, t. Data for this variable should be obtained from harvest schedule information. Values may be constrained by (a) the value of $f_{PRJ,NATURAL,i,t}$ (i.e., $f_{PRJ,HARVEST,i,t} < 1 - f_{PRJ,NATURAL,i,t}$), and/or (b) the area of timber available for commercial harvest.

Methodology Section #	Equation #	Screenshot
8.2.7	37	Incidental loss ($LBL_{PRJ,OTHER,i,t}$; t d.m. yr⁻¹) is the additional live tree biomass removed for road and landing construction in the polygon, i, and is calculated as a proportion of biomass removed by harvesting: $LBL_{PRJ,OTHER,i,t} = A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet f_{PRJ,HARVEST,i,t} \bullet f_{PRJ,DAMAGE,i,t} \quad (37)$ where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, i; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, in year, t (unitless; $0 \leq f_{PRJ,HARVEST,i,t} \leq 1$). $f_{PRJ,DAMAGE,i,t}$ = the proportion of additional biomass removed for road and landing construction in polygon, i, year, t (unitless; $0 \leq f_{PRJ,DAMAGE,i,t} \leq 1$)²⁵. Data for this variable should be based on regional and local comparative studies and experiential information derived from the local forest industry²⁶.
8.2.8	38	The annual change in carbon stocks in DOM ($\Delta C_{PRJ,DOM}$; t C yr⁻¹) is calculated as: $\Delta C_{PRJ,DOM,t} = \Delta C_{PRJ,LDW,t} + \Delta C_{PRJ,SNAG,t} + \Delta C_{PRJ,DBG,t} \quad (38)$ where: $\Delta C_{PRJ,LDW,t}$ = change in lying dead wood (LDW) carbon stocks in year, t; t C yr⁻¹ $\Delta C_{PRJ,SNAG,t}$ = change in snag carbon stock in year, t; t C yr⁻¹ $\Delta C_{BSL,DBG,t}$ = change in belowground carbon stock in year, t; t C yr⁻¹.
8.2.8	39a	$\Delta C_{PRJ,LDW,t} = \Sigma(LDW_{PRJ,IN,i,t} - LDW_{PRJ,OUT,i,t}) \bullet CF \quad (39a)$

Methodology Section #	Equation #	Screenshot
8.2.8	39b	$LDW_{PRJ,i,t+1} = LDW_{PRJ,i,t} + (LDW_{PRJ,IN,i,t} - LDW_{PRJ,OUT,i,t}) \quad (39b)$ where: $LDW_{PRJ,i,t}$ = The total mass of lying dead wood accumulated in polygon i at time t (t d.m.). $LDW_{PRJ,IN,i,t}$ = annual increase in LDW biomass for polygon i, year, t (t d.m ha⁻¹ yr⁻¹). LDW increases occur as a result of natural mortality (typically, blowdown), and as a direct or indirect result of harvesting. $LDW_{PRJ,OUT,i,t}$ = annual loss in LDW biomass through decay, for polygon i, year, t, (t d.m ha⁻¹ yr⁻¹) $LDW_{PRJ,IN,i,t}$ and $LDW_{PRJ,OUT,i,t}$ are summed across polygons. CF = carbon fraction of dry matter (IPCC default value = 0.5).
8.2.8	40	$LDW_{PRJ,IN,i,t} = (LBL_{PRJ,NATURAL,i,t} - LBL_{PRJ,NATURAL,i,t} \bullet R_i) \bullet f_{PRJ,BLOWDOWN,i,t} +$ $((LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i) +$ $(LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i)) \bullet f_{PRJ,BRANCH,i,t} +$

Methodology Section #	Equation #	Screenshot
		$((\text{LBL}_{\text{PRJ,FELLINGS},i,t} - \text{LBL}_{\text{PRJ,FELLINGS},i,t} \bullet R_i) + (\text{LBL}_{\text{PRJ,OTHER},i,t} - \text{LBL}_{\text{PRJ,OTHER},i,t} \bullet R_i)) \bullet (1 - f_{\text{PRJ,BRANCH},i,t}) \bullet f_{\text{PRJ,BUCKINGLOSS},i,t} + \text{SNAG}_{\text{PRJ},i,t} \bullet f_{\text{PRJ,SNAGFALLDOWN},i,t} \quad (40)$ where: $\text{LBL}_{\text{PRJ,NATURAL},i,t}$, $\text{LBL}_{\text{PRJ,FELLINGS},i,t}$, and $\text{LBL}_{\text{PRJ,OTHER},i,t}$ are as calculated in equations 35, 36, and 37, respectively. R_i is the root:shoot ratio in polygon, i (see equation 33b). $f_{\text{PRJ,BLOWDOWN},i,t}$ = the annual proportion of live aboveground tree biomass subject to blowdown in polygon, i, year, t (unitless; $0 \leq f_{\text{PRJ,BLOWDOWN},i,t} \leq 1$). Ex ante estimates must be derived from regional reports in similar forest types. $f_{\text{PRJ,BRANCH},i,t}$ = the annual proportion of aboveground tree biomass comprised of branches ≥ 5 cm diameter in polygon, i (unitless; $0 \leq f_{\text{PRJ,BRANCH},i,t} \leq 1$). Ex ante data are available from allometric equations and models (for example, (Kurz & Apps, 2006) for Canada; (Smith, Miles, Vissage, & Pugh, 2004) for the U.S.). In the event slash burning is undertaken, this parameter should be reduced accordingly to reflect the proportion of biomass remaining. Estimates should be obtained from expert opinion; as a default, assume 100% consumption. $f_{\text{PRJ,BUCKINGLOSS},i,t}$ = the annual proportion of the log bole biomass left on site after assessing and/or merchandizing the log bole for quality, in polygon, i (unitless; $0 \leq f_{\text{PRJ,BUCKINGLOSS},i,t} \leq 1$). Preferably, data for this variable must be based on regional and local comparative studies and experiential information derived from the local forest industry. Otherwise, an average default value of 21% can be used, based on US national summary statistics (Smith, Miles, Vissage, & Pugh, 2004). $\text{SNAG}_{\text{PRJ},i,t}$ = the total mass of the snag pool in polygon, i, year, t (see equation 42b). $f_{\text{PRJ,SNAGFALLDOWN},i,t}$ = the annual proportion of snag biomass in polygon, i, year, t, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{\text{PRJ,SNAGFALLDOWN},i,t} \leq 1$). Ex ante estimates for this parameter can be derived from peer reviewed literature (for example, (Parish, Antos, Ott, & Di Lucca, 2010) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools (for example, (Kurz & al, 2009)).

Methodology Section #	Equation #	Screenshot
8.2.8	41	$LDW_{PRJ,OUT,i,t} = LDW_{PRJ,i,t} \bullet f_{PRJ,lwDECAY,i,t}$ (41) where: $LDW_{PRJ,i,t}$ = the total amount of lying deadwood mass in polygon i, year, t (see equation 39b). $f_{PRJ,lwDECAY,i,t}$ = the annual proportional loss of lying dead biomass due to decay, in polygon i, year, t (unitless; ; $0 \leq f_{PRJ,lwDECAY,i,t} \leq 1$). A common approach to ex ante estimation of $f_{PRJ,lwDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with an a single exponential model, of the general form: $Y_t = Y_o e^{-kt}$ where Y_o is the initial quantity of material, Y_t the amount left at time t, and k is a decay constant (Harmon, et al., 1986). Other types of exponential models are available (reviewed in (Harmon, et al., 1986)) and may be more appropriate to particular forest types (to be described and justified by the project proponent, if used). Ex ante estimates for the decay parameter appropriate for the project should be derived from peer-reviewed literature (for example, (Harmon, et al., 1986); (Laiho & and Prescott, 2004); (Harmon et al, 2008)).
8.2.8	42a	The change in standing dead wood (snag) carbon stock in year, t ($t \text{ C yr}^{-1}$) is calculated as: $\Delta C_{PRJ,SNAG,t} = \Sigma(SNAG_{PRJ,IN,i,t} - SNAG_{PRJ,OUT,i,t}) \bullet CF$ (42a)

Methodology Section #	Equation #	Screenshot
8.2.8	42b	$SNAG_{PRJ,i,t+1} = SNAG_{PRJ,i,t} + (SNAG_{PRJ,IN,i,t} - SNAG_{PRJ,OUT,i,t})$ (42b) where: $SNAG_{PRJ,i,t}$ = The total mass of snags accumulated in polygon i at time t (t d.m.) $SNAG_{PRJ,IN,i,t}$ = annual gain in snag biomass for polygon i, year, t (t d.m ha⁻¹ yr⁻¹). Snag biomass develops as a result of natural mortality. In cases where snags are created through management activities, these should be accounted for here. $SNAG_{PRJ,OUT,i,t}$ = annual loss in snag biomass through decay, or falldown (i.e, transfer to the LDW pool)(t d.m ha⁻¹ yr⁻¹) CF = carbon fraction of dry matter (IPCC default value = 0.5). Note that $SNAG_{PRJ,IN,i,t}$ and $SNAG_{PRJ,OUT,i,t}$ are summed across polygons.
8.2.8	43	$SNAG_{PRJ,IN,i,t} = (LBL_{PRJ,NATURALi,t} - LBL_{PRJ,NATURALi,t} \bullet R_i) \bullet (1 - f_{PRJ,BLOWDOWN,i,t})$ (43) where: $LBL_{PRJ,NATURALi,t}$ is as calculated in equation 35, and $1 - f_{PRJ,BLOWDOWN,i,t}$ is the proportion of live tree aboveground biomass that dies in polygon, i, year, t, but remains as standing dead organic matter (i.e. snags) (unitless; $0 \leq f_{PRJ,BLOWDOWN,i,t} \leq 1$). Ex ante default estimates for this calculation can be derived from literature values (for example (Harmon, et al., 1986); (Runkle, 2000); (Harmon et al, 2008)) and should be matched to the ecosystems that most closely characterize the project area.

Methodology Section #	Equation #	Screenshot
8.2.8	44	$SNAG_{PRJ,OUT,i,t} = SNAG_{PRJ,i,t} \bullet f_{PRJ,SWDECAY,i,t} + SNAG_{PRJ,i,t} \bullet f_{PRJ,SNAGFALLDOWN,i,t}$ (44) where: $SNAG_{PRJ,i,t}$ = the total amount of snag mass in polygon i, year, t (see equation 42b). $f_{PRJ,SWDECAY,i,t}$ = the annual proportional loss of snag biomass due to decay, in polygon, i, year, t (unitless; $0 \leq f_{PRJ,SWDECAY,i,t} \leq 1$). As with lying dead wood, a common approach to estimating $f_{PRJ,SWDECAY,i,t}$ is to assume mass loss occurs in proportion to the amount of mass remaining in accordance with an a single exponential model (see equation 41). Ex ante estimates for this parameter can be derived from peer reviewed literature appropriate for the project site (for example, Vanderwel et al. 2006a) and forest carbon accounting models that track the rates of input and losses from dead organic matter pools for each forest type, productivity, and age-class (see, for example, Vanderwel et al., 2006b; (Kurz & et al, 2009)). $f_{PRJ,SNAGFALLDOWN,i,t}$ = the annual proportion of snag biomass in polygon, i, that falls over and thus is transferred to the LDW pool (unitless; $0 \leq f_{PRJ,SNAGFALLDOWN,i,t} \leq 1$). See equation 40 for parameter estimates.
8.2.8	45a	$\Delta C_{PRJ,DBG,t} = \Sigma(DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t}) \bullet CF$ (45a)
8.2.8	45b	$DBG_{PRJ,i,t+1} = DBG_{PRJ,i,t} + (DBG_{PRJ,IN,i,t} - DBG_{PRJ,OUT,i,t})$ (45b) where: $DBG_{PRJ,i,t}$ = The total quantity of dead belowground biomass accumulated in polygon i at time t (t d.m.). $DBG_{PRJ,IN,i,t}$ = annual gain in dead belowground biomass for polygon i, year, t (t d.m ha⁻¹ yr⁻¹). Dead belowground biomass develops as a result of mortality through natural causes or through harvesting activities. $DBG_{PRJ,OUT,i,t}$ = annual loss in dead belowground biomass through decay, (t d.m ha⁻¹ yr⁻¹) CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.2.8	45c	$DBG_{PRJ,IN,i,t} = [(A_{PRJ,i} \bullet LB_{PRJ,i,t} \bullet R_i) \bullet (f_{PRJ,NATURAL,i,t} + f_{PRJ,HARVEST,i,t} + f_{PRJ,DAMAGE,i,t})]$ (45c) where: $A_{PRJ,i}$ = area (ha) of forest land in polygon, i; $LB_{PRJ,i,t}$ = average live tree biomass (t d.m. ha⁻¹) in polygon, i, for year, t. $LB_{PRJ,i,t}$ is calculated for year, t, beginning with biomass estimates in year $t=1$ (the project start year) and with annual biomass increments ($G_{PRJ,i,t}$) added as per calculations in equation 33 a, b. This value is then multiplied by $A_{PRJ,i}$, the area (ha) of forest land in polygon, i. R_i is the root:shoot ratio in polygon, i (see equation 33b). $f_{PRJ,NATURAL,i,t}$ = the annual proportion of biomass that dies from natural mortality in polygon, i (unitless; $0 \leq f_{PRJ,NATURAL,i,t} \leq 1$), year, t (see equation 35), $f_{PRJ,HARVEST,i,t}$ = the proportion of biomass removed by harvesting from polygon, i, (unitless; $0 \leq f_{PRJ,HARVEST,i,t} \leq 1$), year, t (see equation 36), $f_{PRJ,DAMAGE,i,t}$ = the proportion of additional biomass removed by for road and landing construction in polygon, i (unitless; $0 \leq f_{PRJ,DAMAGE,i,t} \leq 1$), year, t (see equation 37),
8.2.8	45d	$DBG_{PRJ,OUT,i,t} = DBG_{PRJ,i,t} \bullet f_{PRJ,dgbDECAY,i,t}$ (45d) where: $DBG_{PRJ,i,t}$ = the total quantity of dead belowground in polygon i, year, t (equation 17b). $f_{PRJ,dgbDECAY,i,t}$ = the annual proportional loss of dead belowground biomass due to decay, in polygon i, year, t (unitless; $0 \leq f_{PRJ,dgbDECAY,i,t} \leq 1$). The ex ante estimation of the decay of dead belowground biomass should be done using a similar single exponent decay function as that described above for lying deadwood biomass. Estimates for the decay parameter appropriate for specific project should be derived from peer-reviewed literature (see for example: (Moore, Trofymow, Siltanen, Prescott, & CIDET, 2005); (Melin, Petersson, & Nordfjell, 2009).

Methodology Section #	Equation #	Screenshot
8.2.9	46	$\Delta C_{PRJ,HWP,t} = \Delta C_{PRJ,STORHWP,t} - \Delta C_{PRJ,EMITFOSSIL,t}, \quad (46)$ $\Delta C_{PRJ,STORHWP,t}$ = the annual change in harvested carbon that remains in storage after conversion to wood products ($t\ C\ yr^{-1}$) $\Delta C_{PRJ,EMITFOSSIL,t}$ = the annual change in fossil fuel emissions from harvesting (logging and log transport) and processing of the various wood products.
8.2.10	47	The annual change in carbon storage in harvested wood products in year t ($\Delta C_{PRJ,STORHWP,t}$; $t\ C\ yr^{-1}$) is determined based upon the following equation: $\Delta C_{PRJ,STORHWP,t} = (C_{PRJ,STORHWP,t2} - C_{PRJ,STORHWP,t1}) / T \quad (47)$ where: $C_{PRJ,STORHWP,t2}$ = carbon storage in harvested wood products at $t=2$; $t\ C$ $C_{PRJ,STORHWP,t1}$ = carbon storage in harvested wood products at $t=1$; $t\ C$ T = number of years between monitoring $t1$ and $t2$ t : 1,2,3...t years elapsed since the project start date
8.2.10	48	$C_{PRJ,TIMBER,h} = \Sigma[(LBL_{PRJ,FELLINGS,i,h} - LBL_{PRJ,FELLINGS,i,h} \bullet R_i + LBL_{PRJ,OTHER,i,h} - LBL_{PRJ,OTHER,i,h} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,h}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,h})] \bullet CF \quad (48)$ where:

Methodology Section #	Equation #	Screenshot
		$C_{PRJ,TIMBER,h}$ = carbon contained in timber harvested in period h (summed for all harvested polygons, i); t C $LBL_{PRJ,FELLINGS,i,h}$ = annual removal of live tree biomass due to commercial felling in polygon, i; t d.m. (equation 36) $LBL_{PRJ,OTHER,i,h}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. (equation 37) R_i is the root:shoot ratio in polygon, i (see equation 33b). $1 - f_{PRJ,BRANCH,i,h}$ the proportion of live tree biomass remaining after netting out branch biomass, in polygon i (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) $1 - f_{PRJ,BUCKINGLOSS,i,h}$ = the proportion of the log bole remaining after in-woods log processing/bucking for quality, length, etc., in polygon, i (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 40) h = harvest period ; yr
8.2.10	49	$C_{PRJ,MILL,h,k} = (C_{PRJ,TIMBER,h,k} \bullet f_{RND,k} \bullet r_{RND,k})$ (49) where: $C_{PRJ,MILL,h,k}$ = carbon contained in harvested timber after milling in period h, for product type k; t C $C_{PRJ,TIMBER,h,k}$ = carbon contained in timber harvested in period h, for product type k; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) $f_{RND,k}$ = fraction of growing stock volume removed as roundwood for product type k (default values by region in Table 1.5 of the 1605(b) document); dimensionless $r_{RND,k}$ = ratio of industrial roundwood to growing stock volume removed as roundwood for product type k (default values by region in Table 1.5 of the 1605(b) document); dimensionless

Methodology Section #	Equation #	Screenshot
8.2.10	50a	To determine the proportion of harvested wood products (by type) that fall into each category, refer to the “In Use” column for the selected forest region in Table 1.6 in the 1605(b) document. Table 3 provides recommendations for analogs for areas within North America but outside of the conterminous US; the project proponent must justify the appropriateness of the selected analog. Three values are then calculated from these data selected from Table 1.6 in the 1605(b) document, for each product type, k: the short-lived fraction ($P_{PRJ,SLF,k}$), medium-lived fraction ($P_{PRJ,MLF,k}$), and long-lived fraction ($P_{PRJ,LLF,k}$): $P_{PRJ,SLF,k} = 1 - P_{3\text{-year}} \quad (50a)$
8.2.10	50b	$P_{PRJ,LLF,k} = P_{100\text{-year}} \quad (50b)$
8.2.10	50c	$P_{PRJ,MLF,k} = P_{3\text{-year}} - P_{100\text{-year}}, \quad (50c)$ Each category of wood products (k) stores carbon according to the following rules: iv. Short-lived wood products – immediate emission of all carbon upon harvest v. Medium-lived wood products – no emission of carbon upon harvest, but carbon stored will decrease by 1/20th for the next 20 years after harvest, such that after 20 years the term becomes zero vi. Long-lived wood products – no loss of carbon.
8.2.10	51	$C_{PRJ,STORHWP,t} = \sum \sum ((C_{PRJ,MILL,h,k} \cdot P_{LLF,k}) + [(C_{PRJ,MILL,h,k} \cdot P_{MLF,k}) \cdot ((20-h) / 20)]) \quad (51)$ where: $C_{PRJ,STORHWP,t}$ = carbon stored in harvested wood products in year t summed for all product types k and then over all harvest periods h; t C k = wood product type – (softwood saw log, softwood pulpwood, hardwood saw log, or hardwood pulpwood; proportions determined from Table 1.4 of 1605(b) document) h = year of harvest (the term $(20-h)$ should not be allowed to drop below 0)

Methodology Section #	Equation #	Screenshot
8.2.11	52	The annual change in fossil fuel emissions from harvesting and processing of the various wood products ($\Delta C_{PRJ,EMITFOSSIL,t}$) are calculated as: $\Delta C_{PRJ,EMITFOSSIL,t} = C_{PRJ,EMITHARVEST,t} + C_{PRJ,EMITMANUFACTURE,t} + C_{PRJ,EMITTRANSPORT,t} \quad (52)$ Where $C_{PRJ,EMITHARVEST,t}$ = the annual fossil fuel emissions associated with harvesting of raw material (t C yr⁻¹) $C_{PRJ,EMITMANUFACTURE,t}$ = the annual fossil fuel emissions associated with the manufacturing of raw material (t C yr⁻¹) $C_{PRJ,EMITTRANSPORT,t}$ = the annual fossil fuel emissions associated with the transport of raw material (t C yr⁻¹)
8.2.11	53	The simplest approach to calculating $C_{PRJ,EMITFOSSIL,t}$ is to use published or derived carbon emission intensity factors. In the case of harvesting, $C_{PRJ,EMITHARVEST,t}$ (t C yr⁻¹), can be calculated as: $C_{PRJ,EMITHARVEST,t} = \sum [(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \cdot R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \cdot R_i) \cdot (1 - f_{PRJ,BRANCH,i,t}) \cdot (1 - f_{PRJ,BUCKINGLOSS,i,t})] \cdot CF \cdot C_{HARVEST} \quad (53)$ where: $C_{HARVEST}$ = carbon emission intensity factor (t C emitted/t C raw material) associated with harvesting (see Table 4 for default values); all other terms are as defined in equation 19.

Methodology Section #	Equation #	Screenshot
8.2.11	54	$C_{PRJ,EMITTRANSPORT,t}$ must be calculated after consideration of the transport distance from harvest to processing facility, and the means of transportation. This term can be calculated as follows (after (Heath, et al., 2010)): $C_{PRJ,EMITTRANSPORT,t} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet \Sigma(f_{PRJ,TRANSPORTk} \bullet d_{TRANSPORTk} \bullet c_{TRANSPORTk}) \quad (54)$ where: $f_{PRJ,TRANSPORTk}$ = the fraction of raw material transported by transportation type, k. (unitless; $0 \leq f_{PRJ,TRANSPORTk} < 1$). $d_{TRANSPORTk}$ = the distance transported by transportation type, k. (km); $c_{TRANSPORTk}$ = the carbon emission intensity factor (kg C emitted/t C raw material) associated with transportation type, k (see Table 4 for default values); all other terms are as defined in equation 48.
8.2.11	55	$C_{PRJ,EMITMANUFACTURE,t} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,OTHER,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet \Sigma(f_{PRJ,PRODUCTk} \bullet c_{MANUFACTUREk}) \bullet CF \quad (55)$ $c_{MANUFACTUREk}$ = the carbon emission intensity factor (t C emitted/t C raw material) associated with manufacture of product type, k; all other terms are as defined in equation 48.
8.3.3	56a	For project proponents using Market Leakage Option 1: The outcome of the VCS Leakage Discount Factor determination = the value for MLF_y (56a)

Methodology Section #	Equation #	Screenshot
8.3.3	56b	To calculate the project market leakage (LE_y, t CO₂e yr⁻¹): $LE_y = MLF_y \cdot ER_{y,GROSS} \quad (56b)$ Where, MLF_y = Market leakage factor, as calculated above. $ER_{y,GROSS}$ = the gross difference in the overall annual carbon change between the baseline and project scenarios in year 'y' (in tonnes CO₂e yr⁻¹). This term is calculated in equation 57.
8.3.4	56c.1	$BC_{hv, n} = \Sigma[(LBL_{BSL,FELLINGS,i,t} - LBL_{BSL,FELLINGS,i,t} \cdot R_i + LBL_{BSL,OTHER,i,t} - LBL_{BSL,Other,i,t} \cdot R_i) \cdot (1 - f_{BSL,BRANCH,i,t}) \cdot (1 - f_{BSL,BUCKINGLOSS,i,t})] \cdot CF \cdot 44/12 \quad (56c.1)$ As calculated using the <i>baseline scenario data</i>, and where: $LBL_{BSL,FELLINGS,i,t}$ = annual removal of live tree biomass due to commercial felling in polygon, i; t d.m. yr⁻¹ (equation 6) $LBL_{BSL,OTHER,i,t}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. yr⁻¹ (equation 6) $1 - f_{BSL,BRANCH,i,t}$ = the proportion of aboveground live tree biomass remaining after netting out branch biomass, in polygon i (unitless; $0 \leq f_{BRANCH,i,t} \leq 1$)(see equation 12) $1 - f_{BSL,BUCKINGLOSS,i,t}$ = the proportion of the log bole remaining after processing for quality, in polygon, i (unitless; $0 \leq f_{BUCKINGLOSS,i,t} \leq 1$) (equation 12) R_i = the root:shoot ratio in polygon, i CF = carbon fraction of dry matter (IPCC default value = 0.5).

Methodology Section #	Equation #	Screenshot
8.3.4	56c.2	$AC_{inv, n} = \Sigma[(LBL_{PRJ,FELLINGS,i,t} - LBL_{PRJ,FELLINGS,i,t} \bullet R_i + LBL_{PRJ,OTHER,i,t} - LBL_{PRJ,Other,i,t} \bullet R_i) \bullet (1 - f_{PRJ,BRANCH,i,t}) \bullet (1 - f_{PRJ,BUCKINGLOSS,i,t})] \bullet CF \bullet 44/12$ (56c.2) As calculated using the <i>project scenario data</i>, and where: $LBL_{PRJ,FELLINGS,i,t}$ = annual removal of live tree biomass due to restoration felling in polygon, i; t d.m. yr^{-1} (equation 6) $LBL_{PRJ,OTHER,i,t}$ = annual removal of live tree biomass from incidental sources in polygon, i; t d.m. yr^{-1} (equation 6) $1 - f_{PRJ,BRANCH,i,t}$ = the proportion of aboveground live tree biomass remaining after netting out branch biomass, in polygon i (unitless; $0 \leq f_{PRJ,BRANCH,i,t} \leq 1$)(see equation 12) $1 - f_{PRJ,BUCKINGLOSS,i,t}$ = the proportion of the log bole remaining after processing for quality, in polygon, i (unitless; $0 \leq f_{PRJ,BUCKINGLOSS,i,t} \leq 1$) (equation 12) CF = carbon fraction of dry matter (IPCC default value = 0.5).
8.3.4	56c.3	$SE_y = LE_y$ (56c.3) where: SE_y = Secondary Effects in year 'y' (tCO₂e) calculated using equations in Figure 1 and equations 56c.1, 56c.2 and 56c.3. LE_y = Leakage in year y (in tonnes CO₂e yr^{-1}) – used in equation 58.

Methodology Section #	Equation #	Screenshot
8.3.5	56d	For project proponents utilizing Leakage Option 3, project market leakage (LE_Y; t CO₂e yr⁻¹) is calculated as: $LE_Y = MLF_Y \cdot ER_{Y,GROSS} \quad (56d)$ Where, MLF_Y = the market leakage factor in year, y (as calculate per section 8.3.5) $ER_{Y,GROSS}$ = the gross difference in the overall carbon balance between the baseline and project scenarios in year y (t CO₂e yr⁻¹). See equation 57 for its calculation.
8.5	57	Gross carbon emissions reductions ($ER_{Y,gross}$; t CO₂e yr⁻¹) created by the carbon project are calculated annually as the difference between the baseline and project scenario net emission reductions/emissions: $ER_{Y,GROSS} = (\Delta C_{BSL,t} - \Delta C_{PRJ,t}) \bullet 44/12 \quad (57)$ Where, $\Delta C_{BSL,t}$ = total net baseline scenario emissions calculated from equation 1 (t C yr⁻¹). $\Delta C_{PRJ,t}$ = total net project scenario emissions calculated from equation 29 (t C yr⁻¹). 44/12 = factor to convert C to CO₂e

Methodology Section #	Equation #	Screenshot
8.5.1	58	The annual <i>net</i> carbon emissions reductions is the actual net GHG removals by sinks from the project scenario minus the net GHG removals by sinks from the baseline scenario, were then calculated by applying the leakage and uncertainty discount factors (but not the VCS permanence buffer), on an annualized basis: $ER_y = ER_{y,GROSS} - LE_y \quad (58)$ where: ER_y = the net GHG emissions reductions and/or removals in year y (the overall annual carbon change between the baseline and project scenarios, net all discount factors except the permanence buffer) (t CO₂e yr⁻¹). $ER_{y,GROSS}$ = the difference in the overall annual carbon change between the baseline and project scenarios (t CO₂e yr⁻¹). LE_y = Leakage in year y (t CO₂e yr⁻¹), as calculated in equation 56b.
8.5.2	59	The number of VCU's the project available for issuance and sale in year, y (VCU_{y}; t CO₂e yr⁻¹), is calculated as: $VCU_y = ER_y \cdot (1 - ER_{y,ERR}) - BR_y \quad (59)$ where: ER_y = the net GHG emissions reductions and/or removals in year (t CO₂e yr⁻¹), as calculated in equation 58. $ER_{y,ERR}$ = the uncertainty factor for year, y, (calculated in Section 8.5.3), expressed as a proportion. BR_y = estimated VCU-equivalent tCO₂e issued to the VCS Buffer Pool in year, y, calculated using the latest version of the VCS AFOLU Non-Permanence Risk Tool. BR_y is calculated by multiplying the most current verified permanence risk Buffer Withholding Percentage for the project by the change in carbon stocks (difference between baseline and project scenario) for the project area as per the latest approved VCS AFOLU Requirements (Voluntary Carbon Standard, 2008a).

Methodology Section #	Equation #	Screenshot
8.5.3	60a	$E_M = 100 \cdot (\sum y_{d,h,i} / \sum (A_{PRJ,h} \cdot y_{m,h,i})) \quad (60a)$ where: The summation is across all plot observations, i, and across all analysis units, h;
8.5.3	60b	$y_{d,h,i} = A_{PRJ,h} \cdot (y_{m,h,i} - y_{p,h,i}) \quad (60b)$ E_M = Mean model error for the project (%) $y_{d,h,i}$ = the area-weighted difference between measured and predicted carbon storage in analysis unit, h, plot observation, i (t C) $y_{m,h,i}$ = carbon storage measured in analysis unit, h, plot observation, i (t C ha⁻¹) $y_{p,h,i}$ = carbon storage predicted by model for analysis unit, h, plot observation, i (t C ha⁻¹) $A_{PRJ,h}$ = area of project analysis unit, h (ha)
8.5.3	60c	$E_I = 100 \cdot [SE \cdot 1.654 / ((1/N) \cdot \sum (A_{PRJ,h} \cdot y_{m,h,i}))] \quad (60c)$ Where, E_I = Inventory error for the project (%) SE = the project level standard error of the area weighted differences between measured plot observation and predicted values of carbon storage. N = total number of plot observations in all analysis units or polygons³⁷ 1.654 = the 90% confidence interval t-value All other terms as defined in equation 60a.

Methodology Section #	Equation #	Screenshot
8.5.3	60d	$SE = S / \sqrt{N}$ (60d) Where, N = total number of plot observations in all analysis units or polygons (see Footnote 37) S = the standard deviation of the area weighted differences between measured and predicted values of carbon storage across all analysis unit or polygons.
8.5.3	60e	$S = \sqrt{[(1/N - 1) \cdot \sum (y_{d,h,i} - \bar{y}_{bar_d})^2]}$ (60e) Where, $\bar{y}_{bar_d}$ = the project-level mean of the area weighted differences between measured plot observation and predicted values of carbon storage. See equation 60b for the calculation of $y_{d,h,i}$ All other terms as defined in equation 60b and 60c.
8.5.3	60f	$E_p = E_M + E_i$ (60f)
9.3.5	61a	Each piece of dead wood will be assigned to one of three density classes, sound (1), intermediate (2), and rotten (3) (details below). The volume per unit area is calculated for each density class, c, as: $V_{LDW,c} = \pi^2 * [(d_1^2 + d_2^2 \dots d_n^2)/8L]$ (60a) where: d_1, d_2, d_n = diameter (cm) of each of n pieces intersecting the line, and L = the length of the line (100 m default (Harmon, et al., 1986)).

Methodology Section #	Equation #	Screenshot
9.3.5	61b	The mass of LDW in density class, c ($t\ ha^{-1}$), is: $M_{LDW,c} = V_{LDW,c} * D_{LDW,c} \quad (60b)$ where: $V_{LDW,c}$ = the volume per unit area calculated for each density class, c, as calculated in 60a. $D_{LDW,c}$ = the density of LDW in density class, c ($t\ d.m.\ m^{-3}$)
9.3.5	61c	The total mass of LDW in each plot summed over all density classes ($t\ ha^{-1}$) is: $DOM_{LDW} = \sum M_{LDW,c} \quad (60c)$ where: $M_{LDW,c}$ = the mass of LDW in density class, c ($t\ ha^{-1}$), is as calculated in 60b.

APPENDIX 6 – PROJECT AREA POLYGON LOCATION