Ministry of Environment and Climate Change Strategy

British Columbia Greenhouse Gas Offset Protocol: Forest Carbon

Version: 2.0

Director
Greenhouse Gas Industrial Reporting and Control Act

[DATE TBD], 2021

Summary of Revisions

Version	Date	Description
1.0	July 2011	Original version.
-	June 2016	Removed from approved protocol list.
2.0	[DATE TBD] 2021 (draft)	• Definitions added • Extraneous guidance reduced • Protect types modified to the following: 1. Afforestation / Reforestation 2. Conservation / Improved Forest Management 3. Avoided Conversion • Baseline Scenario approach more specific • Modelling requirements more specific • Emission factors and parameter constants updated • Carbon pools renamed as carbon Reservoirs • Some SSRs eliminated or consolidated • Harvest-shifting Leakage factors updated • Requirement for a Monitoring and Maintenance Plan. • Contingency Account and Risk of Reversal requirements added

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1.0 GUIDANCE

The purpose of the British Columbia (B.C.) Greenhouse Gas Offset Protocol for the Creation of Forest Carbon Offsets (the Protocol) is to quantify Greenhouse Gas (GHG) Emission Reductions and carbon dioxide (CO_2) Removal Enhancements by Sinks and Reservoirs of carbon. Failure to comply with this Protocol or requirements of the *Greenhouse Gas Industrial Reporting and Control Act* or Greenhouse Gas Emission Control Regulation may result in a Project Plan not being accepted, or offset units not being issued.

The Protocol has the effect of a regulation.

The Project Proponent is responsible to ensure the Validation Body selected for a Project using this Protocol is accredited by the Standards Council of Canada Technical Sector C: GHG Emission Reductions & Removals from Agriculture, Forestry & Other Land Use (AFOLU), or by the American National Standards Institute Sector for Group 3: Land Use, Land Use Change, & Forestry.

The Project Proponent is responsible to provide justification where any assumptions or estimates are used in the Project Plan.

The Project Proponent is responsible to ensure the requirements of the Protocol, the *Act*, and Regulations are met, and required forms are complete.

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 DEFINITIONS

In the Protocol, the capitalization of terms where the capitalization is not performing a grammatical function indicates a defined term in either the Regulation or this section.

"*Act*" means the *Greenhouse Gas Industrial Reporting and Control Act*.

"Afforestation" means activities that meet the criteria defined in Section 3.2.1.

"Atmospheric Benefits" mean entitlements and/or Offset Units generated from Projects where there are property rights, contractual rights, or right of access to those entitlements and/or Offset Units.

"Avoided Conversion" means activities that meet the criteria defined in Section 3.2.3.

"Baseline" refers to the Greenhouse Gas Emissions generated and activities on the proposed Project Site that would most likely occur in the absence of a proposed Project.

"Baseline Emissions" means the amount of Greenhouse Gas Emissions, established by, or estimated in accordance with, the Protocol that would occur from all selected Sources were the Project not carried out.

"Baseline Removals" means amount of Greenhouse Gas, established by, or estimated in accordance with, the Protocol that would be removed from the atmosphere by all selected Sinks were the Project not carried out.

"Baseline Scenario" means a hypothetical reference case that best represents the conditions most likely to occur in the absence of a proposed Project.

"Biomass" means non-fossilized plants or parts of plants, animal waste, or any product made of either of these and includes, without limitation, Biomass derived fuels, wood and wood products, agricultural residues and wastes, biologically derived organic matter found in municipal and industrial wastes, black liquor, kraft pulp fibres and sludge gas.

"Contingency Account" means an account managed by the Director where, as specified in the protocol, up to 51% of Offset Units issued in relation to a sequestration Project or storage Project must be credited.

"Conservation" means activities that meet the criteria defined in Section 3.2.2.

"Crown land" means land, whether or not it is covered by water, or an interest in land, vested in the government.

"Crediting Period" refers to the 25-year period through which the Primary Activity occurs, and when Project Emission are determined.

"Director" means the government employee designated in writing by the minister as Director for the purposes of the *Greenhouse Gas Industrial Reporting and Control Act*.

"Emissions" means Greenhouse Gases**.**

"Emission Reductions" means Baseline Emissions minus Project Emissions.

“Forest land” means an area:

- That is greater than or equal to one hectare in size measured tree-base to tree-base (Stand-Alone to Stand-Alone), and
- Where trees on the area are capable of achieving:
    1. A minimum height of 5 metres at maturity, and
    2. A minimum crown cover of 25% at maturity.

"Greenhouse Gases" means carbon dioxide, methane, and/or nitrous oxide, measured in metric tonnes of carbon dioxide equivalent.

"Harvest-shifting Leakage” (also known as market Leakage) means the increase in Greenhouse Gas Emissions that occur from outside the Project Site as a result of reduced production of a commodity, causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply.

“Harvested Wood Products” means all wood material (including bark) that leaves harvest sites.

“Improved Forest Management” means activities that meet the criteria defined in Section 3.2.2.

"Land Use-shifting Leakage” (also known as activity-shifting Leakage) means the increase in Greenhouse Gas Emissions that occur from outside the Project Site as a result of the Primary Activity, and see conversion of Forest land shifting to other lands owned or controlled by the Project Proponent due to the Project.

“Leakage” means the increase in Greenhouse Gas Emissions that occur from outside the Project Site as a result of the Primary Activity.

“Materiality Threshold” means a quantitative threshold for verification purposes where the aggregate or individual effects of errors, omissions or misrepresentations could have resulted in an overestimation of Project Reductions by more than 5%, except where stated otherwise for the purposes of quantifying and sampling the Baseline and Project Emissions and Reservoir.

“Monitoring” means the continuous or periodic assessment and documentation of GHG Emissions and Removals or other GHG-related data.

"Monitoring Period" means the 100-year period through which a Project Proponent must ensure Emission Reductions and Removal Enhancements are Permanent.

"Offset Units" means one verified tonne of Emissions reduction or Removal achieved as part of and in accordance with an accepted Emission offset Project in respect of which the Director has received a report of the outcome of the Project and a verification statement in relation to the report.

"Performance Standard" means either a technical, activity or performance measure used to establish the Baseline Scenario, and determine Baseline Emissions or a component of Baseline Emissions, identified in Section 5.1.

"Permanent" means the sequestration of Greenhouse Gases for a 100-year period following the Crediting Period.

"**Primary Activity"** means the main activity or set of activities in the Project Scenario that result in the majority of Emission Reduction from the Baseline Scenario.

"Program of Activities" means a type of Project that is not Stand-Alone where a group of similar Project Instances are covered by a single Project Plan and additional Project Instances may be added to the Project over the course of the Project Crediting Period.

"Project" means a Greenhouse Gas reduction Project as described in the Project Plan.

"Project Emissions" means:

- In relation to a Project Plan, the amount of Greenhouse Gas Emissions, estimated in accordance with the applicable Protocol, that would occur from all selected Sources were the Project carried out; and
- In relation to a Project Report, the amount of Greenhouse Gas Emissions, determined in accordance with the Project Plan, that occurred from all selected Sources in the Project Report Period.

"Project Instance" means, in relation to a Program of Activities, a single instance of a Project Scenario that, in combination with other Project Instances, is covered by the same Project Plan.

"Project Plan" means a plan prepared in accordance with Section 14 of the Regulation (Project Plans).

"Project Proponent" means a person or organization who submits to the Director, directly or though a validation body, a plan for an Emission offset Project that the person proposes to or does carry out. The Project Proponent also refers to any non-controlling shareholder that directs or partially directs day-to-day operations or reporting.

"Project Reduction" means the total of the Emissions Reduction and the Removals Enhancement, less any discounts applied in accordance with the Protocol, that are estimated to occur or that have occurred in the Crediting Period and Monitoring Period.

"Project Removals" means:

- In relation to a Project Plan, the amount of Greenhouse Gases estimated in accordance with the Protocol that, were the Project carried out, would be removed by all selected Sinks; and
- In relation to a Project Report, the amount of Greenhouse Gas, determined in accordance with the Project Plan, removed by all selected Sinks in the Project Report Period.

"Project Report" means a report described in the Regulation that meets the prescribed requirements of both the Regulation and the Protocol for each Project Report Period.

"**Project Report Period**" means, each period for which a separate Project report is or must be prepared.

"Project Scenario" means the activities taken by the Project Proponent that reduce or remove greenhouse gas emissions and constitute the estimation of the Project Emissions.

"Project Site" means the physical footprint where the Primary Activity occurs.

"Project Specific" means an approach to establish the Baseline Scenario that is specific to the Project.

"Protocol" means the Forest Carbon Offset Protocol Version 2.0 (FCOP).

"Reforestation" means activities that meet the criteria defined in Section 3.2.1.

"Regulation" means Greenhouse Gas Emission Control Regulation.

"Removal" means an amount of Greenhouse Gas that is removed from the atmosphere by an industrial or biological process and stored or sequestered, or components of which are stored or sequestered in a Reservoir.

"Removal Enhancement" means Project Removals minus Baseline Removals.

"Reservoir" means a physical unit, or component of the biosphere or geosphere, that has the capability to store or accumulate Greenhouse Gas, or a component of Greenhouse Gas, removed from the atmosphere

"Reversal" means any events that results in a loss of more than five percent of carbon stocks in Reservoirs included in the Project Site, but has not been taken into account of projected Removal Enhancements in the Project Plan.

"Risk of Reversal" means a risk factor addressed in Section 8.4.5.2 and determined in Appendix H that represents the magnitude and likelihood that a Reversal will occur up to 100 years after the Crediting Period ends

"Risk Mitigation Measures" mean the Project-specific actions or attributes undertaken in Appendix H that reduce the overall Risk of Reversal for a Project.

"Sink" means a physical unit or process that removes Greenhouse Gas from the atmosphere.

"Source" means any process or activity through which a GHG is released into the atmosphere.

"Stand-Alone" means a type of Project where all the Instances of the Primary Activity occur on the Project Site of the Project Scenario, and are identified in the validated Project Plan.

2.2 Abbreviations and Acronyms

"AAC"	Annual Allowable Cut
“AC”	Avoided Conversion
“AFF”	Afforestation
“AFOLU”	Agriculture, Forestry and Other Land Use
“ANSI”	American National Standards Institute
“B.C.”	British Columbia
“BE”	Baseline Emission
“BR”	Baseline Reservoir
"C"	Carbon
“CONS”	Conservation
“ESSF”	Engelmann Spruce-Subalpine Fir
“ICH”	Interior cedar-hemlock
“IDF”	Interior douglas fir
“IFM”	Improved forest management
“ISO”	International Organization for Standardization
"GHG"	Greenhouse Gase(s)
“GWP”	Global warming potential
“HWP”	Harvested wood product
“LRDW”	Land and Resource Data Warehouse
“MW”	Molecular weight
“MS”	Montane Spruce
“NIR”	National Inventory Report
“NFI”	National Forest Inventory
“PoA”	Program of Activities
“PE”	Project Emission
“PR”	Project Reservoir
“REF”	Reforestation
“RPF”	Registered Professional Forester
“SBS”	Sub-boreal spruce
“SCC”	Standards Council of Canada
"SSR”	Source, Sink and/or Reservoir
“TASS”	Tree and Stand Simulator
“TIPSY”	Table Interpolation Program for Stand Yield
“TSA”	Timber Supply Area
“VDYP”	Variable Density Yield Projection
“VRI”	Vegetation Resources Inventory
“WCI”	Western Climate Initiative

2.3 Equations

2.4 TABLES

2.5 FIGURES

3.0 ELIGIBILITY

3.1 GENERAL CRITERIA

The following general criteria must be met for Projects:

1. The Primary Activity of the Project Scenario must meet at least one of the definitions and specific eligibility criteria under Sections 3.2.1, 3.2.2, or 3.3.3.
2. For Crown lands:
    a. The Project Proponent must have authority to access and use Crown land (i.e. a tenure, Land Use Agreement, Master Licence of Occupation) for the purpose of developing a Forest Carbon Emission Offset Project, and entitlement to the Atmospheric Benefits for the duration of the Crediting Period and Monitoring Period,
    b. The Project must use genetically diverse and productive seed stock, wherever planting activity happens in Crown lands, and is expected to apply the current version of B.C. Chief Forester's Standards for Seed Use, which prohibit the use of genetically modified trees and limit the use of species collected outside of B.C.,
    c. The Project Proponent shall conduct a local stakeholder and/or community engagement prior to validation as a way to inform the design of the project and maximize community participation. The Project Proponent shall establish mechanisms for ongoing communication with the local community to allow individuals or organizations to raise concerns about potential negative impacts during Project implementation. Further, the Project Proponent shall take due account of all and any input retrieved during engagement, and must either incorporate into Project design (with documentation) or justify why updates are not appropriate.
3. For privately-held land, the Project Proponent must provide:
    a. Proof of fee-simple ownership for duration of the Crediting Period and Monitoring Period.
4. The Project Proponent is required to disclose in writing to the Validation Body / Verification Body any and all instances of non-compliance with any legal or regulatory requirement associated with Project lands in B.C. or Canada.
5. None of the Project Reductions result from reductions in GHGs other than CO_2, CH_4 and N_2O.
6. The Project Proponent, Validation Body, and Verification Body must all have a Registered Professional Forester (RPF) on their project teams. The RPF must be accredited with the Association of BC Forest Professionals for practice in B.C., and must have credentials that are pertinent to the Project as defined by the *Forester's Act*.

3.2 PROJECT TYPES

Project Proponents may select from the three Project types below.

3.2.1 Afforestation / Reforestation

Project Type Definition:

Afforestation (AFF) is defined as the direct human-induced conversion of land that has not been Forest land for at least 20 years prior to Project commencement to Forest land through planting, seeding and/or human-induced promotion of natural seed Sources. Areas suitable for AFF Projects include, but are not limited to:

- Marginal productivity land,
- Urban land,
- Agricultural land, or
- Degraded industrial lands.

Reforestation (REF) is defined as the re-establishment of trees through planting, seeding and/or human-induced promotion of natural seed sources on land that has been Forest land within the last 20 years prior to Project commencement.

Specific Eligibility Criteria:

- In assessing whether land is capable of achieving the height and crown cover criteria specified in the Forest land definition, Project Proponents must consider what the land is capable of achieving in the absence of a change in current (i.e. pre-Project) management practice.
- Where the Project also involves Improved Forest Management on Project lands where there are also tree planting activities, the Project must be treated as an Improved Forest Management Project according to the requirements of this Protocol and not a tree planting Project. Where a requirement for a tree planting Project is more stringent than for an Improved Forest Management Project (e.g. for determination of relevant versus optional or not relevant SSRs), the more stringent requirement is to be applied.

3.2.2 Conservation / Improved Forest Management

Project Type Definition:

Conservation / Improved Forest Management (CONS/IFM) is defined as a system of practices for stewardship and use of Forest land, which may include production of harvest wood products that reduces GHG Emissions and/or increases GHG Sinks / carbon Reservoirs. CONS projects are not prevented from including a planned harvest cycle.

Eligible management activities may include one or more of a variety of approaches:

- Increase sequestration rates (e.g. through fertilization, improving stocking, reducing regeneration delays, use of faster growing trees/seed, etc.),
- Reduce Emissions (e.g. through capturing mortality, reducing natural disturbances, reducing burning, reducing new road widths, incremental Biomass recovery, etc.), and
- Increase long-term carbon storage in forests and wood products (e.g. through establishment of conservation areas, reduced harvesting through forest cover constraints, increasing rotation age, increasing proportion of long lived Harvested Wood Products in conjunction with other changes in forest management, etc.).

Specific Eligibility Criteria:

- Project lands must meet the definition of 'Forest land' for the 20 years immediately prior to the start of the Project.

3.2.3 Avoided Conversion

Avoided Conversion (AC) means preventing the direct human-induced conversion of Forest land to a non-Forest land use. Logging as part of forest management is not included as a potential conversion activity under this definition, however AC Projects are not prevented from including a planned harvest.

Avoided land-uses includes residential, commercial, industrial, agricultural, and Crown land held in fee-simple for municipalities.

Specific Eligibility Criteria:

- Project lands must meet the definition of 'Forest land' for the 20 years immediately prior to Project commencement, in order to demonstrate that the Project avoids the conversion of Forest land.
- Project Lands must be suitable for conversion. The evidence and analysis a Proponent should provide in supporting that the Project would be fit for AC must include one or more of the following professional services:
    - Highest and Best Use Analysis to determine the reasonably probable use of a property that is legally permissible under current zoning, physically possible, financially feasible, and maximally productive.
    - Feasibility Analysis to determine if a Project will fulfill the objectives of an investor.
    - Market Analysis to determine the supply and demand of a property type and the geographic market area for that property type.
    - Marketability Study to predict how a property will be absorbed under current market conditions.

  Evidence must be prepared by a Designated Member of the Appraisal Institute of Canada. As per the Canadian Uniform Standards of Professional Appraisal Practice, the appraisal report must have sound judgement and sound reasoning, with sufficient depth and detail, including robust qualitative and quantitative data, to support a sound determination of highest and best use, the impact of any charges and encumbrances on title, prevailing market trends and the final valuation.
- The Project Proponent must demonstrate that there is an imminent threat of conversion of Project land to a non-Forest land use, according to the Baseline selection requirements in this Protocol. Project Proponents must also include evidence that there is an imminent threat of conversion be included in the Timber Supply Area (TSA), zoning, or appraisal.

3.3 Project Start Date

The Project Start Date must be no earlier than January 1, 2017 in accordance with the *Act* and Regulation. Projects accepted under the *Cap and Trade Act* and also accepted by the Director under the *Act* would refer to the original start date of those projects. Project start date must coincide with proof of ownership (see Section 3.1 of this protocol).

For Program of Activities (PoA), the Project Start Date is the date of first Project Instance(s).

3.4 PROJECT CREDITING PERIOD

The Project Crediting Period is 25 years unless an extension is authorized under the Regulation. The Project Report Period is a minimum of 12 consecutive months and a maximum of five consecutive years.

3.5 MATERIALITY THRESHOLD

For the purpose of this Protocol, any errors, omissions, or misrepresentations are considered material if the individual or aggregate effects result in an overestimation or underestimation of the Project Emissions, Emission Reductions, or Removal Enhancements of more than 5% for Projects with net Emission Reductions and Removal Enhancement under 500,000 tonnes of CO_2e (tCO_2e) per calendar year over a Project's Crediting Period, and 2% for Projects with net Emission Reductions and Removal Enhancements over 500,000 tCO_2e per calendar year over a Projects Crediting Period.

3.6 DEMONSTRATING ADDITIONALITY

Offset units will only be issued for actions that are considered additional to those that could reasonably be assumed to have happened without the Project.

Project Proponents must demonstrate that the Primary Activities of the Project will result in Emission Reductions and Removals that exceed:

- Common practice or "business-as-usual" conditions, and
- Any law, regulation, permitting conditions or other legally binding mandate associated with the related activity or Project Site to reduce or remove Emissions (with the exception of Regulatory Requirements that were a result of the Project being implemented as determined in Section 6.0).

The Project Proponent must assert that the Project has not received any financial incentive, including direct funding or a reduction in applicable fees or tax burden reductions on a per unit of reduction/removal basis and that the incentive created by participating in the carbon market was among the main motivating factors for the implementation of the Project.

4.0 PROJECT SITE

4.1 DESCRIPTION OF THE PROJECT

The Project Proponent must provide a description of the Project including where the Project will be carried out and where the Project's Emission Reductions and/or Removal Enhancements will occur.

The Project Plan must indicate whether the Project type is Stand-Alone or PoA.

4.2 IDENTIFICATION OF THE PROJECT AREA

A forest offset Project Proponent must provide geographical information about the location where the Project will be carried out and any other information allowing for the unique identification of the Project. The Project can be contiguous or separated (non-contiguous) tracts.

4.2.1 Stand-Alone Location(s)

Stand-Alone geographic information must include a geo-referenced map that shows the Project area. The Project Proponent is required to use Provincial base mapping, corporate spatial data stored by Data BC. Project area consists of, and must be assessed along the following boundary types:

- Regional Study Area, which is typically based on a natural transition (*e.g.*, watershed boundary, ecological zone) or an artificial delineation (*e.g.*, political or economic district or zone) that is relevant to the Project.
- Local Study Area, which comprises a slightly smaller area, but where the Project Proponent identifies areas that may be influenced by the Project. Within this scale, a Leakage-assessment-area should be included if applicable.
- Footprint, or Project Site, wherein the Project activities will occur.

The map provided must be at a sufficiently large scale, the minimum requirements are: 1:10 000 to 1:50 000, and include sufficient features, place names and administrative boundaries to enable field interpretation and positive identification of the Project area.

The following information must be provided on the map:

- Forest ownership and Project Site (as discussed above).
- Size of forest ownership area.
- Latitude/longitude, or land title or land survey.
- Existing land cover and land use.

The Project Proponent must also provide other Project identification and description information as required by the Regulation.

4.2.2 Program of Activity Locations

Project Plans for a Project involving a PoA must identify the geographic boundary within which the Primary Activity of the Project Scenario will be occurring, and how each Project Instance will be uniquely identified.

For all Project Instances implemented at the time of validation, Project Plans must provide Global Positioning System coordinates for the location of each Project Instance and any other relevant information allowing for the unique identification of all Project Instances. Each of the Project Instances must include a geo-referenced map with the same requirements as those Project's that are Stand-Alone location(s)

Project Plans of PoAs must describe in detail the approach that will be used for identification of Project Instances that are not determinable when the Project Plan is validated. Project Plans must include a description of how this approach will enable future verifications and inspections to identify each individual Project Instances and ensure the reported Project Instances that have been implemented are uniquely identifiable.

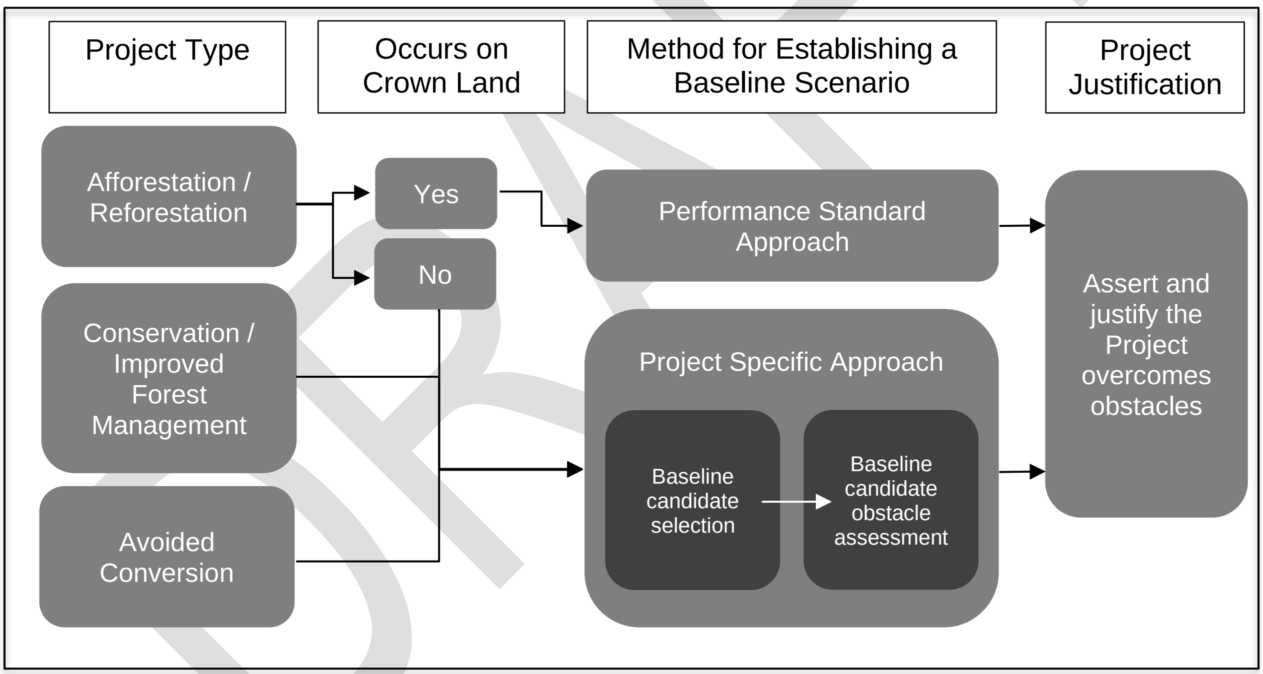
As per Section 3.1, Project Proponents must demonstrate right of access for each Project Instance.

5.0 ESTABLISHMENT OF BASELINE SCENARIO

To justify the Project, Project Proponents must establish a Baseline Scenario. The Baseline Scenario describes the activities on the Project Site and associated emissions that would have most likely occurred in the absence of the Project. The Baseline Scenario is either determined using a pre-established Performance Standard approach, or a Project Specific approach of Baseline Scenario candidates. For all Baseline Scenario approaches, Project Proponents must determine whether their Project meets specific eligibility criteria described in Section 3.0. Project Proponents must also provide evidence to support the assertion that the Project meets the requirements of each Baseline Scenario approach.

Eligibility for the Performance Standard and Project Specific approaches varies by Project type. See Figure 1 below. Following selection of the Baseline Scenario, Project Proponents must assert and justify the Project as per Section 6.0.

Figure 1: Selection of Baseline Scenario Approaches and Project Justification



5.1 PERFORMANCE STANDARD APPROACH

For the Performance Standard approach, AFF/REF Project Proponents must determine whether their Project meets specific eligibility criteria described in Section 3.2.1. If Project Proponents meet the eligibility criteria and the Project Site is on Crown land, they must use the Performance Standard Baseline Scenario established in this section to estimate their Baseline Emissions.

5.1.1 Identifying a Performance Standard Baseline

AFF and REF Projects on Crown land must use the Performance Standard Approach. AFF and REF Projects on non-Crown land, including private, municipal, reserve land, Aboriginal title land, or other non-Crown land, must use the Project Specific Approach under Section 5.2.

Eligible Project Proponents must select one of the following three types of Performance Standard Baseline Scenarios that may apply depending on attributes specific to the Project:

1) A Regulatory Requirements Baseline Scenario, or
2) A continuation of historic activities Baseline Scenario, or
3) A hybrid of continuation of historic activities and Regulatory Requirements Baseline Scenario.

The Project Plan must demonstrate which form of Performance Standard Baseline Scenario is applicable for the Project. The following conditions determine whether a Project Proponent uses a Regulatory Requirement Performance Standard Baseline Scenario or a continuation of historic activities Performance Standard Baseline Scenario. The Project Plan must identify and supply sufficient evidence to demonstrate which criterion has been met and provide an assertion that the selected criterion has been met.

Performance Standard Baseline Scenario Conditions

1. Projects without any Regulatory Requirement must use a continuation of historic practices/activities as the Baseline Scenario.
2. Projects that face Regulatory Requirements that were not a result of the Project being implemented as determined in Section 6.0 must use those Regulatory Requirements as the Baseline Scenario. Project Proponents must also take into account provincial or federal incentives or Regulatory Requirements relevant to any aspect of the Baseline Scenario, including tax incentives and grants.

5.1.2 Selecting a Performance Standard Baseline Scenario

The Baseline Scenario for a Performance Standard approach is the threshold or activity described in Section 3.2.1. The Project Proponent must assert in the Project Plan that the Baseline Scenario will result in the most conservative estimate of the Project Reductions.

5.2 PROJECT SPECIFIC APPROACH

AFF/REF Projects on private land eligible under Section 3.2.1, CONS/IFM Projects eligible under Section 3.2.2, and AC Projects eligible under Section 3.2.3 must use the Project-Specific approach for determining the Baseline Scenario. Under this Baseline Scenario approach, Project Proponents must identify and select a Baseline Scenario representing what would have most likely occurred in the absence of the Project. The Baseline Scenario must ensure a conservative estimate of the Project Reductions. The Project Proponent must first identify plausible Baseline Scenario candidates assuming the Project had not taken place and then systematically assess the validity of each, considering any obstacles and Regulatory Requirements facing each Baseline Scenario candidates.

5.2.1 Identification of Baseline Scenario Candidates

The Project Specific Baseline Scenario approach must identify all Baseline Scenario candidates. Baseline Scenario candidates for AFF/REF projects must be selected from Section 5.2.1.1, Baseline Scenario candidates for CONS/IFM Projects must be selected from Section 5.2.1.2, and Baseline Scenario candidates for AC Projects must be selected from Section 5.2.1.3.

The assessment must consider each type of candidate (hypothetical natural resource management practice or activity) individually, and include a clear description of what each activity involves (associated activities, schedules, etc.). Candidates must use a time-horizon identical to that of the proposed Project.

All Project Proponents must include the following candidates:

- Initiating the project without carbon financing,
- Continuation of historic practices (unless there has been a acquisition of the Project Site in the past 20 years, in which case this candidate is optional), and
- New regulatory requirements.

Continuation of historic practices baseline candidate requirements

To determine the historic natural resource management activities in place prior to commencement of the Project, the Project Proponent must prepare a verifiable record of historic natural resource management (including timber harvesting) practices occurring on the Project Site prior to the Project, for a period of at least 20 years. The Project Proponent must also assess (with documentation) whether or not in the absence of the project, the land would continue to be managed according to historic forest management practices by considering at minimum:

- Existing or proposed regulatory requirements,
- Provincial or Federal incentives,
- Financial implications of historic forest management practices, and
- Common forest management practices within a geographic region that includes the Project, with the size of the region and time period considered to be justified by the proponent.

5.2.1.1 Baseline Scenario Candidates for Afforestation/Reforestation Projects

AFF/REF projects may use all the following Baseline Scenario Candidates:

- Project without carbon financing
- Production of commercial crops
- Pastureland, abandoned land, or degraded land
- Land development (i.e. residential, commercial, or industrial)
- Continuation of historic practices and regulatory requirements
- New regulatory requirements that do not justify the project as determined in Section 6.0 Project Justification

5.2.1.2 Baseline Scenario Candidates for Conservation/Improved Forest Management Projects

CONS/IFM projects may use all of the following Baseline Scenario Candidates:

- Project without carbon financing
- Park or protected area status
- Harvest to projected Annual Allowable Cut (AAC) (Crown land)
- Harvest at historical harvest rates, or continuation of historic practices and regulatory requirements
- New regulatory requirements that do not justify the project as determined in Section 6.0 Project Justification.
- Harvest to long-term sustainable yield

5.2.1.3 Baseline Scenario Candidates for Avoided Conversion Projects

AC project may use all of the following Baseline Scenario Candidates:

- Project without carbon financing
- Park or protected area status
- Harvest at historical harvest rates, or continuation of existing management and regulatory requirements
- New regulatory requirements that do not justify the project as determined in Section 6.0 Project Justification.
- Scenarios that reflect the nature of land development activities in the region
- Proposed (but not yet in effect) natural resource management activities for the Project lands (which defines the type of land use that the Project would intend to avoid by initiating the Project)

A Project Proponent must provide the following documentary and explanatory evidence for each of the Baseline Scenario candidate:

- An assessment of development practices, including development density, typical development area to meet the stated need, typical extent of deforestation, and timing of development. For land uses selected as equivalent to the selected Baseline Scenario candidate, the size of the region and time period must be justified by the Project Proponent.
- If the Baseline Scenario candidate does not reflect identified common development practices, then the Project Proponent must provide an explanation of why the Baseline Scenario candidate would be different for the Project Site, including the identification and explanation of key criteria used to make the assessment.
- Where the Baseline Scenario candidate does not involve developing the Project Site in a way that satisfies non-Forest land demand in the Baseline Scenario, for example, where the Project involves managing the Project Site as a forest with no development, or where Project development differs from Baseline Scenario candidate development:
  - An approved development plan / permit for the Project Site issued within two years of Project Start Date indicating that the Baseline Scenario candidate development has been approved, or
  - A written offer to purchase the Project Site issued within the two years prior to Project start, by a developer that is completely independent of the Project Proponent, and where it can be convincingly demonstrated that the developer would have undertaken the development and deforestation of the Project lands

according to the selected Baseline Scenario candidate (including how any identified obstacles to the Baseline Scenario would be overcome), or
    - An economic analysis of the selected Baseline Scenario candidate demonstrating the Baseline Scenario candidate is financially viable and more attractive than maintaining the Project lands as Forest land without development and more financially attractive than the Project.

Projects that involve developing the Project Site in a way that satisfies non-Forest land demand in the Baseline Scenario must consider the financial viability of the Project as part of the Project justification assessment described in Section 6.0.

5.2.2 Identification of Baseline Scenario Candidate Obstacles

The Project Plan must identify any potential obstacles associated with each of the Baseline Scenario candidates identified as per Section 5.2.1, in order to assess, as per Section 5.2.3, which of the Baseline Scenario candidates would have been the most likely to occur in the absence of the Project, considering both the number and magnitude of the obstacles.

5.2.2.1 Baseline Scenario Candidate Obstacle Types

Project Proponents must identify obstacles that would discourage a decision to implement the Baseline Scenario candidates. Project Proponents must consider, at minimum, financial, legal and technical obstacles that each identified Baseline Scenario candidate may face.

Examples of Baseline Scenario candidate obstacles include:

- The Baseline Scenario candidate is less financially attractive than the Project Proponent's established and documented internal investment hurdle rate even taking into account existing government climate change or other incentives,
- The Baseline Scenario candidate faces restrictions on access to capital (e.g. due to high up-front capital costs),
- The Baseline Scenario candidate faces certain supply chain challenges (e.g. cost effectively getting their product to market cost or delivering an important input to the Project site),
- The Baseline Scenario candidate involves technologies / approaches with which the Project Proponent is not experienced (e.g. not a core business of the Project Proponent). Thus, even if profitable, the Project Proponent would not normally have undertaken the Baseline Scenario candidate, and
- The Baseline Scenario candidate faces legal obstacles that prevent it from being undertaken.

5.2.2.1.1 Avoided Conversion Baseline Scenario Candidate Obstacles

The Project Proponent must include in the assessment of each Baseline Scenario candidate obstacles, at minimum, when evaluating each Baseline Scenario candidate for AC Projects:

- Legal, including consideration of zoning by-laws, development permits, tree protection by-laws, riparian regulations, covenants, easements, existing right of ways and any other relevant Project land-specific, local or other legal requirements,
- Official community development plans,
- Official regional growth strategies, and

- Strategic land-use plans and higher-order plans (e.g. as emerge from land and resource management planning processes).

5.2.3 Comparative Assessment of Baseline Obstacles

Project Proponents must present a comparative assessment of obstacles for each of the Baseline Scenario candidates. Project Proponents must identify both the presence of an obstacle and estimate the magnitude of the obstacle for each Baseline Scenario candidate identified as per Section 5.2.2. The magnitude of an obstacle must be quantified as much as practicable. In addition, the magnitude of an obstacle may also be characterized qualitatively using descriptive explanations and justifications for the characterization. In the Project Plan, Project Proponents must substantiate and explain the cumulative effects of the obstacles for each Baseline Scenario candidate. The results of cumulative effects must be presented so that a reasonable person could form an opinion as to which of the Baseline Scenario candidates is most likely to occur.

For clarity, as part of this selection, in accordance with Section 14(3)(n)(v)(A) of the Regulation, Project Proponents must take into account provincial or federal incentives or Regulatory Requirements relevant to any aspect of the Baseline Scenario, including tax incentives and grants. In accordance with Section 14(3)(n)(v)(B) of the Regulation, in the Project Plan, the Project Proponent must also include in the assessment the financial implications of carrying out a course of action referred to in the Baseline Scenario, and any other factor relevant to justifying the assertion that the estimate of future Project Reductions will be conservative in accordance with Section 14(3)(n)(v)(C).

5.2.4 Selecting a Project Specific Baseline Scenario

Based on the results of the comparative assessment of Baseline Scenario obstacles, a Project Proponent must determine and justify which of the Baseline Scenario candidates is the most reasonably likely to occur. Where there is only one Baseline Scenario candidate that is reasonably likely to occur, the Project Plan establishes that Baseline Scenario candidate as the Baseline Scenario. Where there are multiple Baseline Scenario candidates that are reasonably likely to occur, the Project Plan establishes a Baseline Scenario that will result in the most conservative estimate of the Project Reduction supported with adequate and appropriate justification for the selection. The Project Proponent must assert in the Project Plan that that the Baseline Scenario will result in the most conservative estimate of the Project Reductions.

5.3 ADJUSTMENTS TO THE BASELINE SCENARIO

The Baseline Scenario may be adjusted if there are substantive changes to applicable inputs, candidates, or candidate obstacles.

6.0 PROJECT SCENARIO JUSTIFICATION

Project Proponents must assert and justify in the Project Plan that there are financial, technological, or other obstacles to carrying out the Project that are overcome or partially overcome by the incentive of having the Project Reductions recognized as Offset Units under the *Act*. Project scenario obstacle identification uses the same process as Section 5.2.2. The justification in the Project Plan must include:

- Financial analysis including the impact of carbon finance on investment hurdle rates and decision-making, and
- How the economic business case and values used in the financial analysis compare to those commonly used by the Project Proponent and industry-specific standards.

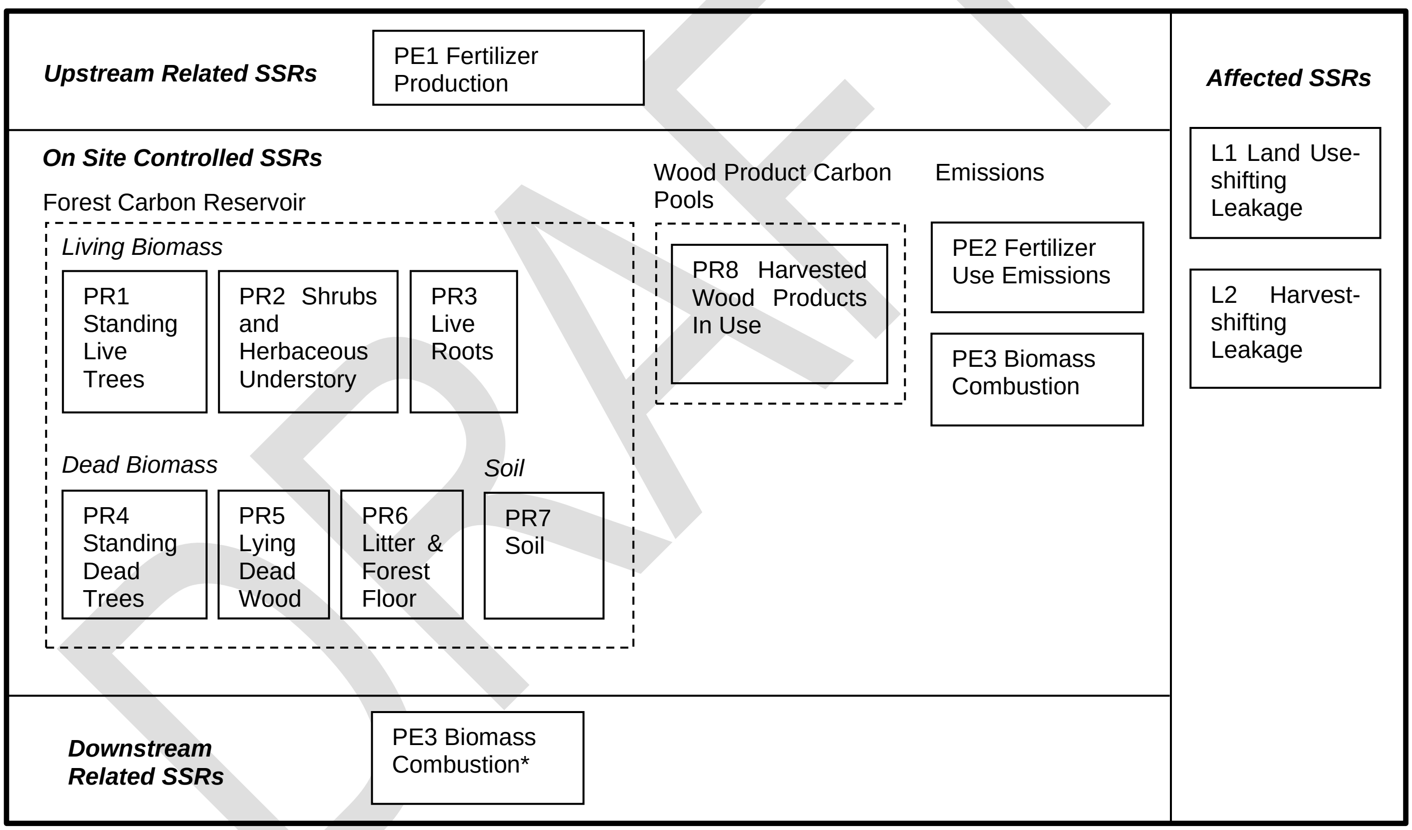
The situation where a Project creates Emission Reductions and/or Removal Enhancements partially or wholly through an agreement with government to change legislation or regulation for the purposes of increasing carbon sequestration and thereby creating incremental Project Reductions may constitute evidence of overcoming or partially overcoming obstacles.

Project Proponent must assert that the Emissions Reduction projected in the Project Plan have not been or will not be applied in relation to a regulatory requirement under another enactment and therefore, are in excess of those GHG Emission regulatory requirements. Project Proponents must also clearly identify any regulatory requirements that may come into force.

7.0 Categorization and Description of Selected Project and Baseline SSRs

All Sinks, Sources and Reservoirs (SSRs) are categorized as controlled, related, or affected (C / R / A) based on their relation to the Project Proponent, where the Project Proponent is assumed to control all on-site and mobile SSRs and upstream and downstream SSRs are assumed to be controlled by others and, thus, are related to the Project. If applicable, affected SSRs are determined separately in Section 8.08.3. Figure 2 shows the various SSRs and their relation to the Project.

Figure 2: Project SSRs – All Eligible Project Types



* PE3 Biomass Combustion is determined both on-site and downstream

7.1 Categorization of Project and Baseline SSRs

Subject to any limitations in the description column of Table 1, the Project Plan must include all SSRs identified in Table 1 that are applicable to their Project type as 'included', and may include SSR identified as "Project Proponent Justification" as applicable by the Project Proponent. The Project Plan must not include any SSRs that are not listed in Table 1. Potential SSRs that would be subject to carbon pricing are omitted from this protocol. Where the Project Plan lists an SSR, Emissions or Removals of all GHGs listed for that SSR are to be included. In Table 1, the letter in column 1 under heading SSR denotes whether the SSR is Project (P) or Baseline (B) and the number denotes the SSR reference value.

7.2 SELECTED RELEVANT PROJECT AND BASELINE SSRS

Table 1: Selected Relevant Project and Baseline SSRs

SSR	Controlled, Related or Affected		GHG	Included/Excluded			Description
	Baseline	Project		AFF/REF	C/IFM	AC	
Removal Sinks and Reservoirs							
PR1/BR1 Standing Live Trees	Controlled	Controlled	CO_2	Included	Included	Included	Standing live trees include the stem, branches, and leaves or needles of all above ground live Biomass, regardless of species. A minimum diameter at breast height threshold may be justified by the Project Proponent based on the requirements of models and field sampling techniques used.
PR2/BR2 Shrubs and Herbaceous Understory	Controlled	Controlled	CO_2	Included	Optional.	Optional	All above-ground live woody and other plant Biomass that does not meet the description of Standing Live Trees. Note on Optional for CONS/IFM Projects and AC Projects: Project Proponent may elect to consider this SSR to be relevant, but this carbon Reservoir is typically very small in established forests and IFM Projects.
PR3/BR3 Live Roots	Controlled	Controlled	CO_2	Included	Included	Included	Portions of living trees, shrubs or herbaceous Biomass located below ground, principally roots.
PR4/BR4 Standing Dead Trees	Controlled	Controlled	CO_2	Included	Included	Included	Standing dead trees include the stem, branches, roots, or section thereof, regardless of species. Stumps are not considered standing dead stocks. A minimum diameter at breast height threshold may be justified by the Project Proponent based on the requirements of models and field sampling techniques used.
PR5/BR5 Lying Dead Wood	Controlled	Controlled	CO_2	Project Proponent Justification	Project Proponent Justification	Project Proponent Justification	Any piece(s) of dead woody material from a tree (e.g. dead boles, limbs, and large root masses) on the ground in forest stands. Lying dead wood is all dead tree material with a minimum average diameter of 12.5cm and a minimum length of 2.4m. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood. Note on Project Proponent Justification: Project Proponent may elect to consider this SSR to be relevant, but explanation is not required to deem this SSR as not relevant, since AFF

SSR	Controlled, Related or Affected		GHG	Included/Excluded			Description
	Baseline	Project		AFF/REF	C/IFM	AC	
							projects would increase carbon stored in the lying dead wood carbon Reservoir relative to the Baseline. Note on Included for REF Projects and IFM Projects: This SSR is included if it cannot be demonstrated that the Project will involve the same amount or more carbon being stored in the lying dead wood carbon Reservoir than the Baseline.
PR6/BR6 Litter & Forest Floor	Controlled	Controlled	CO_2	Project Proponent Justification	Project Proponent Justification	Project Proponent Justification	Any piece(s) of dead woody material from a tree (e.g. dead boles, limbs, and large root masses) on the ground in forest stands that is smaller than material identified as lying dead wood. Note for AFF Projects and AC Projects: Project Proponent may elect to consider this SSR to be relevant, but explanation is not required to deem this SSR as not relevant, since AFF Projects would increase carbon stored in the Litter carbon Reservoir relative to the Baseline. Note for REF Projects and IFM Projects: Unless it is demonstrated that the Project will involve the same or more carbon being stored in the Litter carbon Reservoir than the Baseline, this SSR may be conservatively deemed not relevant.
PP7/BR7 Soil	Controlled	Controlled	CO_2	Conditional	Conditional	Conditional	Belowground carbon not included in other Reservoirs including Stand-Alone. Soil pits are ≥ 60 cm deep, unless bedrock or a water table is encountered before reaching this depth (depth starting at surface of the mineral soil). In deep organic soils, the soil pit should be excavated to a minimum depth of 100 cm when possible. Can be a net Sink or Emission Source depending on the circumstances. Note on Included: SSR is included if the Project exceeds the soil disturbance limits as set out in Section 35 (3), Part 4, Practice Requirements, Division 1 — Soils of the *Forest and Range Practices Act, Forest Planning and Practices Regulation*, regardless of whether or not the Regulation would otherwise apply to the Project Site. Also relevant where the Project involves lowering the water table relative to the Baseline case through physical alteration of the Project Site (e.g. trenching).

SSR	Controlled, Related or Affected		GHG	Included/Excluded			Description
	Baseline	Project		AFF/REF	C/IFM	AC	
PR8/BR8 Harvested Wood Products in Use	Related	Related	CO_2 CH_4	Included	Included	Included	Wood that is harvested or otherwise collected from the forest, transported outside the forest Project Site, and being processed or in use. Includes raw wood products, finished wood products, and any wood residuals generated during the HWP lifecycle that is still in use (i.e. has not been burned, disposed of, etc.).
Emission Sources							
PE1/BE1 Fertilizer Production	Related	Related	CO_2 CH_4 N_2O	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Raw material extraction through to final production of fertilizers that are used throughout the Project.
PE2/BE2 Fertilizer Use Emissions	Controlled	Controlled	N_2O	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Application of nitrogen-based fertilizers and associated Emission pathways, including Emission from soil, volatilization, leaching and runoff.
PE3BE3 Biomass Combustion	Controlled	Controlled	CO_2 CH_4 N_2O	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Included if PE > BE. If not, then Excluded	Emissions from the combustion of harvested forest Biomass at the Project Site, or downstream of the Project Site for various purposes, including for heating, slash pile burning, or HWP processing.
Leakage							
L1/L2 Forest Carbon and Wood Product Reservoirs Located Outside of the Project Physical Boundary that are Indirectly Affected by the Project Activity	Affected	Affected	CO_2 CH_4 N_2O	Conditional – see Note for Included and Excluded	Conditional – see Note for Included and Excluded	Conditional – see Note for Included and Excluded	Changes in the amount of carbon stored in forest and/or wood product carbon Reservoirs located outside of the Project Site indirectly caused by the Project. See Section 7.2.1 for more information.

7.2.1 Notes on the Categorization and Description of Leakage (L1/L2)

Project activities that result in the change in the level of a service provided from within the Project Site (e.g. amount of wood harvested or wood products produced) may result in changes in the level of services provided outside the Project Site, including areas within as well as outside B.C., due to market forces or shifting of forestry activities to another location.

Such changes, which are often referred to as 'Leakage,' may result in changes in the amount of carbon stored in forest and/or wood product carbon Reservoirs located outside of the Project Site. These changes caused by the Primary Activity, might serve to cancel out or mitigate Emission Reductions or enhanced sequestration achieved by the Project within the Project Site. A description and further determination of Leakage is included in Section 8.3.1 and Section 8.3.2.

7.2.1.1 Land Use-shifting Leakage

Note on Included: SSR is included in the following situations, as long as Project Emissions from affected Reservoirs are positive:

- AFF/REF Projects, where shifting to other lands owned or controlled by the Project Proponent ("internal Leakage").

Note on Excluded: SSR is excluded if Project Emissions from affected Reservoirs is zero or negative, or in the following situations:

- AFF/REF Projects, where shifting is to lands outside the ownership or control of the Project Proponent. This type of Leakage is not expected to occur for Projects in B.C. since it is not anticipated that an AFF/REF Project would occur on land that was being actively and profitably being used for other activities (e.g. farming, grazing, industrial use, etc.), given the economics and financial obstacles associated with AFF/REF Projects.
- CONS/IFM Projects must not cause land use change.

7.2.1.2 Harvest-shifting Leakage

Note on Included: SSR is included as long as Project Emissions from affected Reservoirs are positive where the Project results in a decrease in HWP production relative to the Baseline.

Note on Excluded: SSR is excluded if Project Emissions from affected Reservoirs is zero or negative, or where the Project results in no change or an increase in HWP production relative to the Baseline, including Projects where there was no harvesting in the Baseline.

7.3 EXCLUSIONS

Project Proponents may exclude Sources from calculation if it can be demonstrated that Project Emissions will be sufficiently less than Baseline Emissions. Project Proponents may only exclude Reservoirs if indicated in Table 1.

8.0 Quantification of Emission Reductions and Removal Enhancements

For each selected SSR identified in Table 1, a calculation method is provided for quantifying associated GHG Emissions in the Project and Baseline Scenarios in the following sections. All SSRs must be reported in tonnes of carbon dioxide equivalent.

Net Project Emission Reductions and Removal Enhancements are determined through Equation 1.

Equation 1: Net Project Emission Reductions and Removal Enhancements in CO_2e

$$\Delta CO_2 e_{net} = \Delta GHG_{net} - L1 - L2 - \mathrm{CON}_{\beta} - Other\ deductions$$

Where,

Parameter	Description	Default Value
$\Delta CO_2 e_{net}$	Net Emission Reductions and Removal Enhancements of CO_2e, in tonnes, achieved by the Project Proponent during reporting period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number.	N/A
ΔGHG_{net}	Net incremental Emission Reductions and Removal Enhancements of CO_2e before deductions, achieved by the Project during the Project Report Period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number. Determined using Equation 2.	N/A
L1	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined using Equation 20.	N/A
L2	Net increase in Project Emissions due to Harvest-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined in Section 0.	N/A
CON_{β}	Contributions to the Contingency Account during each Project Report Period. Expressed as tCO_2e. Determined using Equation 28.	N/A
Other deductions	Other deductions established in an Atmospheric Benefits Agreement, Indigenous Atmospheric Benefit Agreement, Atmospheric Benefits Sharing Agreement, or other contractual obligations (if relevant) (tCO_2e).	N/A

Emissions factors can be found in the National Inventory Report (NIR) unless stated otherwise. A summary table of current emission factors and constants can be found in Appendix A.

Equation 2: Net Project Emission Reductions and Removal Enhancements Before Deductions

$$\Delta GHG_{net} = \Delta GHG_{Project,t} - \Delta GHG_{Baseline,t}$$

Where,

Parameter	Description	Default Value
ΔGHG_{net}	Net incremental Emission Reductions and Removal Enhancements of CO_2e before deductions, achieved by the Project during the Project Report Period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number.	N/A
$\Delta GHG_{Project,t}$	Total Emissions or Removals of CO_2e occurring in the Project during the Project Report Period *t* (tCO_2e). Determined using Equation 3.	N/A
$\Delta GHG_{Baseline,t}$	Total Emissions or Removals of CO_2e occurring in the Baseline during the Project Report Period *t* (tCO_2e). Determined using Equation 19.	N/A

Retroactive adjustments to Baseline or Project Emission Reductions or Removal Enhancements from previous Project Reporting Periods is encouraged, but will not be considered as justification for retroactive crediting by the Regulator in the event adjustments to estimates or modelling occur resulting in additional Emission Reductions or Removal Enhancements for retroactive Project Report Periods. If it is determined that the use of modelled results led to over-crediting of the Project, then the Project Proponent must indicate such on the current Project Report, and must deduct credits from net Emission Reductions and Removal Enhancements of that current Project Report Period (and subsequent Project Report Periods if applicable).

8.1 QUANTIFICATION OF PROJECT EMISSIONS AND REMOVALS

Project Emission Reductions and Removal Enhancements are determined with Equation 3.

Equation 3: Total Project Emission Reductions or Removal Enhancements

$$\Delta GHG_{Project,t} = \Delta T_{(PR1\ to\ PR7)} + T_{PR8} - T_{PE1} - T_{PE2} - T_{PE3} - T_{PE4} - T_{PE5}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{Project,t}$	Total Emissions or Removals of CO_2e occurring in the Project during the Project Report Period *t* (tCO_2e).	N/A
$\Delta T_{(PR1\ to\ PR7)}$	Emissions and Removals by Project live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined using Equation 4.	N/A
T_{PR8}	Mass of CO_2 stored in Project HWPs during each Project Report Period (tCO_2e). Determined using Equation 7.	N/A
T_{PE1}	Emissions from PE1 from fertilizer production that will be applied during each Project Report Period (tCO_2e). Determined using Equation 10.	N/A
T_{PE2}	Emissions from PE2 from nitrogen application within the Project Site during each Project Report Period (tCO_2e). Determined using Equation 11.	N/A
T_{PE3}	Emissions from PE3 from Biomass combustion within the Project Site and downstream during each Project Report Period (tCO_2e). Determined using Equation 18.	N/A

8.1.1 PR1 to PR7 Live and Dead Forest Carbon Reservoirs

Project Reservoirs (PR) PR1 to PR7 associated with Project forest growth must be determined using **Error! Reference source not found.**, Equation 5, and Equation 6 below.

Equation 4: Converting Carbon to Carbon Dioxide Units

$$\boldsymbol{\Delta T_{(PR1\ to\ PR7)}} = \sum \boldsymbol{\Delta T_{PCR}} \times \frac{\boldsymbol{MW_{CO2}}}{\boldsymbol{MW_C}}$$

Where,

Parameter	Description	Default Value
$\Delta T_{(PR1\ to\ PR7)}$	Emissions and Removals by Project live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e).	N/A
ΔT_{PCRi}	Change in total Project carbon Reservoir in mass for SSR *i* during each Project Report Period (tC). Determined using Equation 5.	N/A
MW_{CO_2}	Molecular weight of CO_2.	44 g/mole
MW_C	Molecular weight of carbon.	12 g/mole

Equation 5: Summation of Change in Carbon Reservoirs

$$\Delta T_{PCR_i} = \Delta PCR1 + \Delta PCR2 + \Delta PCR3 + \Delta PCR4 + \Delta PCR5 + \Delta PCR6 + \Delta PCR7$$

Where,

Parameter	Description	Default Value
$\Delta T_{PCR,i}$	Change in total Project carbon Reservoir in mass for SSR *i* (tC) during the Project Report Period.	N/A
$\Delta PCR1$	Change in carbon by Project Reservoir standing live trees during the Project Report Period (tC).	N/A
$\Delta PCR2$	Change in carbon by Project Reservoir shrubs and herbaceous understory during the Project Report Period (tC).	N/A
$\Delta PCR3$	Change in carbon by Project Reservoir live roots during the Project Report Period (tC).	N/A
$\Delta PCR4$	Change in carbon by Project Reservoir standing dead trees during the Project Report Period (tC).	N/A
$\Delta PCR5$	Change in carbon by Project Reservoir lying dead wood during the Project Report Period (tC).	N/A
$\Delta PCR6$	Change in carbon by Project Reservoir litter & forest floor during the Project Report Period (tC).	N/A
$\Delta PCR7$	Change in carbon by Project Reservoir soil during the Project Report Period (tC).	N/A

Equation 6: Reporting Change of Carbon in Reservoirs

$$\Delta T_{PCR,i} = PCR_{i,t} - PCR_{i,t-1}$$

Where,

Parameter	Description	Default Value
$\Delta T_{PCR,i}$	Change in total Project carbon Reservoir in mass for SSR *i* (tC) during the Project Report Period.	N/A
$T_{PCRi,t}$	Project carbon Reservoir for SSR *i* in Project Report Period *t*.	N/A
$T_{PCRi,t-1}$	Project carbon Reservoir for SSR *i* in Project Report Period *t – 1*.	N/A

The Reservoirs are identified by a Project Proponent in the Project Plan as selected based on the requirements in Section 6.07.2. Project Proponents must demonstrate in the Project Plan that the components of forest carbon included in the definitions of each selected Reservoir were assessed as part of the quantification approach used.

Guidance Note: PR7 Soil

Where soil carbon is selected as a carbon Reservoir by the Project Proponent, the Project Proponent must ensure that either:

- The forest carbon model employed have the capability to quantify changes in soil carbon between the Project and Baseline over time, or
- Direct field sampling for assessing soil carbon is selected and paired with the selected forest carbon models.

A Project Proponent must justify their selection of a soil carbon quantification method, taking into account Project-specific details including the Baseline Scenario. The Project Proponent must indicate in the Project Plan how their approach will result in a conservative estimate of Project Reductions, considering the associated uncertainty. The frequency of field measurement must be consistent with the requirements for assessing other forest carbon Reservoirs as described later in the Protocol (i.e. at least every 10 years). Soil carbon assessment must include a full site-specific soil profile.

Where uncertainty cannot be effectively managed (as defined in the field sampling method), and where soil carbon is an optional Reservoir in Table 1, this carbon Reservoir may not be selected for quantification.

8.1.1.1 Quantification Approach and Associated Uncertainty

There are two options for quantification of carbon Reservoirs in the Project Scenario:

a) Periodic direct field sampling measurement coupled with conversion factors / equations to convert the measured forest attributes (i.e. diameter at breast height and height) into amount of stored Biomass/carbon, or
b) Modelling / Inventory approach using current forest inventory information coupled with growth and yield models to project future forest status.

8.1.1.1.1 Field Sampling Method (Direct Measurement)

The Project Proponent must use Vegetative Resource Index (VRI) or National Forest Inventory (NFI) standards for conducting field sampling and forest inventories, and this sampling must be supervised by a qualified RPF. Sample plots must be chosen using a justified statistically valid approach appropriate for the Project (e.g. that reflects any site stratification, etc.).
Project Proponents that select the field sampling method must demonstrate in the Project Plan that the following requirements have been met:

- Field sampling must be conducted at minimum once every 10 years, including at the start of the Project and at the end of the Project. A Project Proponent is permitted to report on and claim Offset Units from Emission Reductions and Removal Enhancements in years where sampling was not conducted (e.g. annual reporting is still permitted based on the average between the two periods).
  - Verification Bodies must conduct a site audit as part of each verification.
- Results of the sampling must be converted into amounts of stored carbon in relevant forest carbon Reservoirs based on justified assumptions. The targeted sampling error for total Biomass/carbon should be less than or equal to 20% at 90% confidence level for both plantation and natural forests. In converting sampling results to amount of forest carbon, the principle of conservativeness must apply.

- Where a Project includes multiple Project Instances, Project Instances must be homogenous, otherwise non-homogenous Project Instances must be measured separately.

8.1.1.1.2 Inventory / Modeling Method (Indirect Measurement)

While rigorous re-measurement of field conditions typically provides more precision than modeled projections, for large and diverse forest estates (or in some cases small but remote Projects) intensive sampling may be prohibitively expensive. For diverse tracts, modelling forest carbon changes for each stand, or for stratified groupings of similar stands, over time with amalgamation of results across the Project landbase may provide sufficiently accurate estimates without intensive field sampling. This approach would focus on tracking and verification of the timing and extent of any Project activities, along with some minimum level of field measurement at the Project Site, though the type and level of measurement would be determined by the Project Proponent (see below for further details).

Vegetation Resource Inventory standards (VRI) must be used to develop a new forest inventory if the VRI is not available for the Project. At each Project Reporting Period, Project Proponents must update projections for any disturbances that have occurred on the landbase (e.g. harvesting, etc.) and based on the results of any valid field sampling that is conducted. For Crown land, the accuracy assessments and quality assurance associated with VRI datasets are currently available and updated on an ongoing basis. The Project Proponent is required to use the best available inventory data each Project Report Period.

Project Proponents that select the inventory / modeling method must demonstrate in the Project Plan that the following requirements have been met:

- A sensitivity analysis of modelled results to determine the key potential Sources of uncertainty and then evaluate the uncertainty associated with those Sources.
- A justification for the approach to managing above uncertainties.
- A conservative estimate of the Project Reductions.
- Where a Project includes multiple Project Instances under a PoA, Project Instances must be homogenous, otherwise non-homogenous Project Instances must be measured sampled separately.

As noted above, some minimum level of field measurement at the Project Site is required even where a Project Proponent is relying primarily on modelled results, to assist with minimizing the uncertainty associated with modelling, especially over time. The type and level of measurement is to be determined by the Project Proponent, and should be reflected in an overall assessment of uncertainty prepared by the Project Proponent. Such field measurement must be conducted at least once every 10 years, to align with the requirements of the Field Sampling Method, above. When sampling is conducted, results must be used to re-calibrate model results.

Project Proponents that select the inventory / modeling method must follow the same sampling requirements as the field sampling method.

8.1.1.2 Estimating Harvest Flow

The following requirements apply to estimating harvest flow and not to determine harvest volumes based on monitored harvest data.

For projects off and on Crown land, Project Proponents must demonstrate how they are accounting for climate-related risk in the short, medium, and long-term.

Baseline and Project harvest data must be included in meters cubed and hectares for each Project Report Period. Where a Project is a PoA, each Project Instance must itemize Baseline and Project harvest data in meters cubed and hectares for each Project Report Period.

8.1.1.2.1 Non-Crown Land Projects

For non-Crown land, Project Proponents must develop and justify an approach appropriate for their Project, and subject to requirements detailed elsewhere in this protocol. Project Proponents must provide evidence that harvest flow is consistent with local best practices, and in accordance with the Baseline Scenario candidate established in Section 5.2.1.

8.1.1.2.2 Crown Land Projects

During the Project Crediting Period, Project harvest data must be monitored by the Project Proponent and reported at each Project Report Period.

The Project Proponent must estimate sustainable harvest flows for the Baseline and Project Scenarios in accordance with timber supply analysis standards commonly used by Forest Analysis and Inventory Branch in Timber Supply Reviews in B.C. Timber supply Projections must be generated using methods that are documented and repeatable. The Project Proponent must demonstrate in the Project Plan that how the following principles have been met:

a) The long-term harvest level must be sustainable, as indicated by a stable long-term total growing stock,
b) Any declines in normal harvest levels in the short- to mid-term must be no more than or equal to 10% per decade,
c) Any increase in timber supply from mid-term to long-term level must be less than or equal to 10% of normal harvest levels per decade, and
d) Current AAC level must be maintained in the short-term, and be consistent with the principles a), b), and c) above. If the current AAC cannot be achieved while meeting principles a), b) and c), such as maximum 10% per decade rate of decline and maintaining the maximum mid-term level, Project documentation must provide justification. Such an explanation may simply be that any increase above the timber supply levels shown in the forecasts would result in disruption in the forecast during the specified time period. Note, this does not mean that the AAC must be used as the sole basis for harvest flow.

In the description above, short, medium and long-term have the following meanings:

- Short-term – the first 20 years of the forecast.
- Mid-term – the time period between the short and long terms.
- Long-term – usually a period starting from 60 to 100 years from the Project Start Date, and is the time period during which the Projected harvest level is at the sustainable long-term level (which in turn is defined as the level that results in a flat total growing stock over the long term).

The same methodology for deriving the harvest flow must be used for both the Baseline and the Project (except where monitored Project data is being used and the Baseline is based on estimates), and the specific method must be documented (including quantities such as maximum allowable inter-period change in long-term growing stock in determining the long-term sustainable level and the inter-period change in Projected timber supply level).

8.1.1.3 Forest Carbon Model

Estimates of forest carbon values by forest ecosystem carbon models may be performed by linking two or more models or with a single integrated model. Growth and yield models must be used to estimate values for existing and projected tree volume and other characteristics given starting conditions and site characteristics. Models used to estimate volume must have been used previously in B.C.'s Timber Supply Review. The Variable Density Yield Projection (VDYP), and Tree & Stand Simulator (TASS)/Table Interpolation for Stand Yields (TIPSY) are officially used in BC for province-wide growth and yield projections. TIPSY must be used for managed second growth stands, while the VDYP must be used for unmanaged natural stands. Minimum Operational Adjustment Factors (OAF) of OAF1 and OAF2 are 0.85 and 0.95, respectively. Growth and yield, forest inventory, and disturbance information used in the Carbon Budget Model (CBM-CFS3 (Kurz et al. 2009)) approximates national and forest management unit-level forest carbon accounting in Canada to estimate forest carbon values. The CBM-CFS3 is required for use in this Protocol. Model inputs (including data editors for climate, disturbance events and management activities, disturbance matrices, growth and yield curves, inventory, transition rules, default data, and all assumptions) must be included as appendices to the Project Plan.

The Province does not assume any liability in the case of model errors that affect Project Reductions.

Gaming or exploiting differences between models in Project planning is not acceptable. Validation Bodies and Verification Bodies must ensure the conservative and consistent use of model parameters and assumptions.

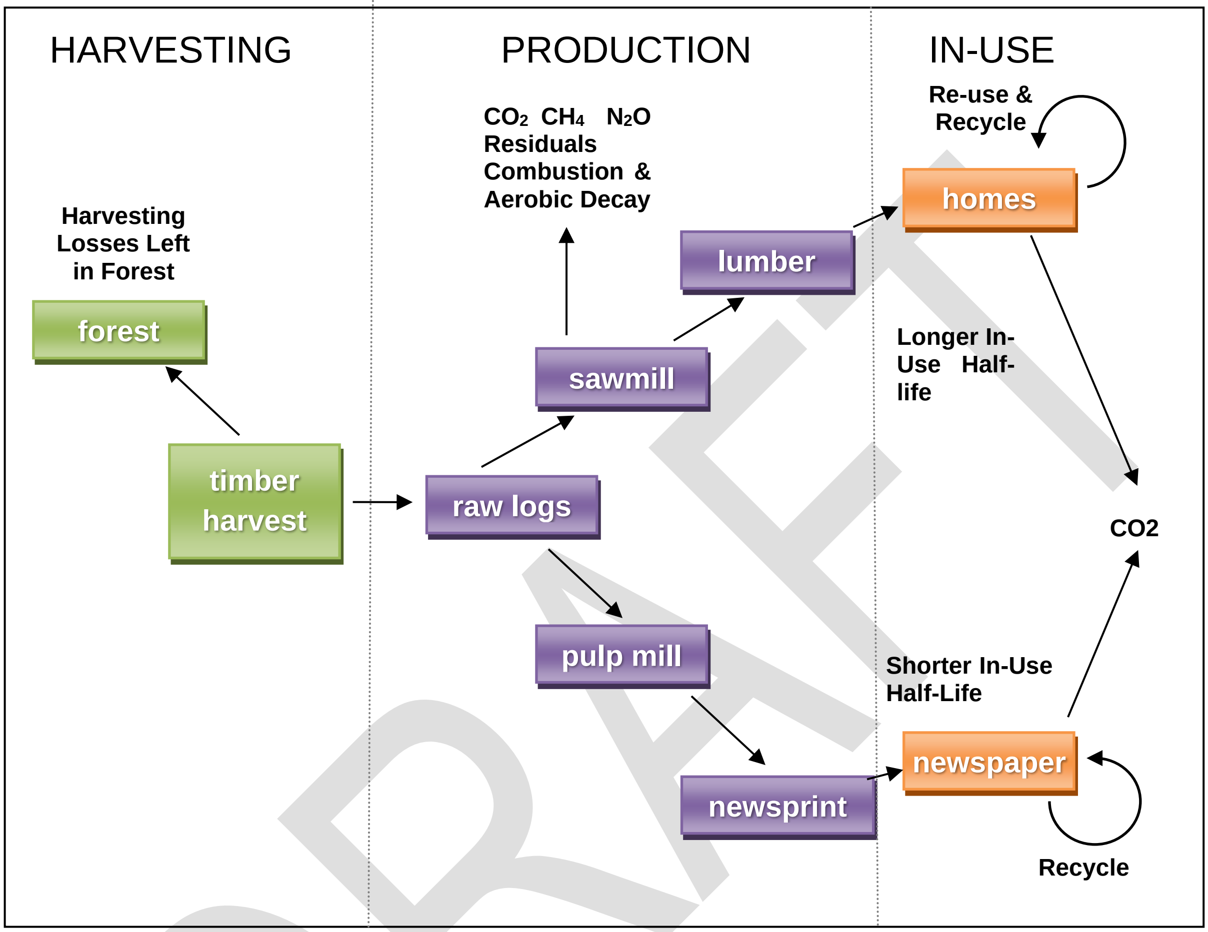
8.1.2 PR8 Harvested Wood Products In-Use

The method contains approaches for calculating carbon quantities in the HWP Reservoir for both North America (US and Canada) and offshore uses. Emission curves for both North American and offshore use, as well as for standard product mixes, specific Project are provided. Since a portion of the carbon initially stored in HWPs is known to be lost over time, the approach presented here involves assessing the amount of wood product carbon that is lost at various stages along the HWP lifecycle. The methodology uses separate data sets to estimate retention of HWP carbon Reservoirs for HWPs in North America, and offshore.

Project Proponents must ensure that they include in their Project calculations any changes which may have been made to these resulting factors.

The methodology described in this section applies to HWP In-Use Reservoirs, and does not consider storage within landfills or dumps. HWP sent to landfill is considered conservatively assumed to be emitted as CO_2 in this Protocol.

Figure 3: HWP Lifecycle



An assessment of the amount of carbon stored in HWPs in-use over a 100-year period must include the following:

- Amount of carbon removed from the forest in harvested wood (net of on-site harvesting losses),
- Amount of carbon lost during production of wood products (e.g. at the sawmill, during the pulp and paper process, etc.) and assumed combusted (and emitted as CO_2 with minor amounts of CH_4 and N_2O) and/or otherwise aerobically lost to the atmosphere as CO_2,
- Amount of carbon in primary HWPs that remains in-use over the 100-year period,
- Amount of carbon in primary HWPs that does not remain in use for the full 100-year period but that is at some point combusted or sent to landfill and conservatively assumed to be emitted as CO_2,
- For HWPs in use in North America, quantification of these processes has been conducted by Natural Resources Canada in the NIR, quantifying carbon storage in HWPs in use, for B.C. forest products in North America and offshore.

The Project Proponent may choose one of the following two approaches for quantifying HWP storage:

1. **Default approach** – standard HWP mixes for both North American and offshore HWP utilization.
   Using this approach, in-use is based on standard product mixes for North American and offshore markets (See Table 2 below). This approach allows Project Proponents to calculate HWP Reservoirs (determined in Equation 7) using standard tables.

2. **Optional approach** – all harvested wood carbon is assumed to be immediately emitted as CO_2. This approach is only available to Projects where the harvest is greater than or equal to the harvest volumes of the Baseline Scenario.

   Harvest flow for both the Project and Baseline Scenario must be developed in accordance with the requirements stipulated in Section 8.1.1.2.

Equation 7: GHGs from Harvested Wood Products

$$T_{PR8} = \sum(GrossHWPCO_{2_{NA}} \times HWPfact_{NA} + GrossHWPCO_{2_{O}} \times HWPfact_{O})$$

Where,

Parameter	Description	Default Value
T_{PR8}	Mass of CO_2 stored in Project HWPs during each Project Report Period (tCO_2e).	N/A
$GrossHWPCO_{2NA}$	Mass of tCO_2e in delivered roundwood extracted from the Project Site during the Project Report Period, destined for use in North America. Determined using Equation 8.	N/A
$GrossHWPCO_{2O}$	Mass of tCO_2e in delivered roundwood extracted from the Project Site during the Project Report Period, destined for use offshore of North America (*O*). Determined using Equation 8.	N/A
$HWPfact_{NA}$	The factor, derived from Table 2, for the proportion of CO_2 remaining after the number of years between harvest and the Project Report Period, for products used in North America (*NA*). Measured as a proportion.	Table 2
$HWPfact_{O}$	The factor, derived from Table 2, for the proportion of CO_2 remaining after the number of years between harvest and the Project Report Period, for products used offshore *O*. Measured as a proportion.	Table 2

Table 2: Fraction of typical BC product mix remaining in-use

Year	North America	Offshore	Year	North America	Offshore
0	0.62	0.88	19	0.32	0.31
1	0.58	0.75	20	0.31	0.30
2	0.55	0.65	25	0.28	0.27
3	0.52	0.58	30	0.25	0.25
4	0.49	0.53	35	0.23	0.22
5	0.47	0.49	40	0.21	0.20
6	0.45	0.46	45	0.19	0.18
7	0.44	0.43	50	0.17	0.16
8	0.42	0.41	55	0.15	0.15
9	0.41	0.40	60	0.14	0.13
10	0.40	0.39	65	0.12	0.12
11	0.39	0.37	70	0.11	0.11
12	0.38	0.36	75	0.10	0.10
13	0.37	0.35	80	0.09	0.09
14	0.36	0.35	85	0.08	0.08
15	0.35	0.34	90	0.08	0.07
16	0.34	0.33	95	0.07	0.06
17	0.33	0.32	100	0.06	0.06
18	0.33	0.32			

Determining Gross Mass of HWP (*$GrossHWPCO2_d$*)

For each Project Report Period and location of use, convert volumes to tonnes of dry Biomass.

Equation 8: Gross Mass of Carbon in Harvested Wood Products

$$GrossHWPCO2_d = RWBiomass_d \times f_{C,wood} \times \frac{MW_{CO_2}}{MW_C}$$

Where,

Parameter	Description	Default Value
$GrossHWPCO2_d$	Mass of tCO_2e in delivered roundwood extracted from the Project Site during each Project Report Period, for each wood product destination *d* (i.e., North America or offshore). Measured in tCO_2e.	N/A
$RWBiomass_d$	Dry mass of the delivered roundwood extracted from the Project Site during each Project Report Period for each wood product destination *d* (i.e., North America or offshore). Measured in tonnes dry Biomass. Determined using Equation 9.	N/A
$f_{C,wood}$	Fraction of the dry mass of wood, excluding bark, that is carbon.	Assumed to be 50% for all wood species.
MW_{CO2}	Molecular weight of CO_2.	44 g/mole
MW_C	Molecular weight of carbon.	12 g/mole

Roundwood Biomass (*$RWBiomass_d$*)

Calculate or estimate volume of roundwood delivered to the mill (or exported), from the Project Site, by species, year and wood product destination (NA or offshore). Harvest flow for both Project and Baseline must be developed in accordance with the requirements stipulated in Section 8.1.1.2. Volumes must be for wood only (not including bark).

Equation 9: Roundwood Biomass

$$RWbiomass_d = \sum_s vol_{s,d} \times wdf_s$$

Where,

Parameter	Description	Default Value
$RWBiomass_d$	Dry mass of the delivered roundwood extracted from the Project Site in each Project Report Period, for each wood product destination *d* (North America or offshore). Measured in tonnes dry Biomass.	N/A
$vol_{s,d}$	Volume of delivered roundwood in m^3 of species *s* for each wood product destination *d*, extracted from the Project Site in each Project Report Period.	N/A
wdf_s	Wood density factor for species *s*, from	Table 3

	Table 3. Measured in t/m^3.	

Table 3: BC-specific wood density factors (wdf_s) for oven-dry stemwood to convert from inside-bark harvested volume (m^3) to mass

B.C. Species or genus	Wood density to 2 significant figures ($t\ m^{-3}$)
Red alder (Alnus rubra)	0.42
Trembling aspen (Populus tremuloides)	0.42
Western red cedar (Thuja plicata)	0.35
Yellow cypress (Chamaecyparis nootkatensis)	0.45
Douglas-fir (Pseudotsuga menziesii)	0.50
True firs (Abies spp.)	0.40
Western hemlock (Tsuga heterophylla)	0.47
Western larch (Larix occidentalis)	0.64
Lodgepole pine (Pinus contorta)	0.46
Ponderosa pine (Pinus Ponderosa)	0.46
Spruce (Picea spp.)	0.43
Sitka spruce (Picea sitchensis)	0.41

8.1.3 PE1 Fertilizer Production Emissions

Emissions from upstream fertilizer production are to be determined using Equation 10.

Equation 10: PE1 Fertilizer Production Emissions

$$T_{PE1} = \sum_{f} EF_f \times AL_f \times CF_f$$

Where,

Parameter	Description	Default Value
T_{PE1}	Emissions from PE1 from fertilizer production that will be applied during each Project Report Period (tCO_2e).	N/A
EF_f	Emission factor for GHG and fertilizer type *f*.	See below
AL_f,	Quantity of fertilizer of type *f* applied during each Project Report Period.	N/A
CF_f	Conversion factor to be used if the units of the activity level do not match those of the Emission factor for a particular fertilizer type *f*. Where both the activity level and Emission factor are expressed in the same units, CF would be set to 1.	N/A

Determining the Emission factor

Emission factors appropriate for the production of nitrogen-based fertilizers in question must be selected from the Canadian NIR. In the event that an appropriate Emission factor is not included in the NIR, the latest IPCC factor may be used. Otherwise, Emission factors found in peer reviewed Sources relevant to the Project Site conditions may be used. A summary table of Emission factors can be found in Appendix A.

Determining the activity level

Quantities of different types of fertilizer applied must be monitored during the Project.

8.1.4 PE2 Fertilizer Use Emissions

N_2O Emissions from Fertilizer Use

N_2O Emissions that result from anthropogenic N inputs occur directly (from the soil to which N is added) and indirectly: (i) volatilization and redeposition of nitrogen compounds, and (ii) leaching and runoff of nitrogen compounds, mainly as nitrate. Both direct and indirect Emissions are quantified for this SSR from the following sources:

- Synthetic nitrogen fertilizer.
- Organic nitrogen applied as fertilizer (e.g. manure, compost, and other organic soil additives).

Total N_2O Emissions related to fertilizer use is determined using the Equation 11.

Equation 11: PE2 Fertilizer Use Emissions

$$T_{PE2} = N_2O_{direct} + N_2O_{indirect}$$

Where,

Parameter	Description	Default Value
T_{PE2}	Emissions from PE2 from nitrogen application within the Project Site during each Project Report Period (tCO_2e).	N/A
N_2O_{direct}	Direct Emissions of N_2O as a result of nitrogen application within the Project Site during each Project Report Period. Determined using Equation 12.	N/A
$N_2O_{indirect}$	Indirect Emissions of N_2O as a result of nitrogen application within the Project Site during each Project Report Period. Determined using Equation 15.	N/A

Direct N_2O Emissions

The direct nitrous oxide Emissions from nitrogen fertilization must be estimated using the following equations:

Equation 12: Direct Fertilizer Use Emissions

$$N_2O_{direct} = [(M_{SN} \times (1 - Frac_{GASF}) + (M_{ON} \times (1 - Frac_{GASM}))] \times EF_{f,direct} \times \frac{MW_{N_2O}}{MW_N}$$

Where,

Parameter	Description	Default Value
N_2O_{direct}	Direct Emissions of N_2O as a result of nitrogen application within the Project Site during each Project Report Period.	N/A
M_{SN}	Mass of synthetic fertilizer nitrogen applied, tonnes of N during each Project Report Period. Determined using Equation 13.	N/A
$Frac_{GASF}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for synthetic fertilizers.	0.1
M_{ON}	Mass of organic fertilizer nitrogen applied, tonnes of N during each Project Report Period. Determined using Equation 14.	N/A
$Frac_{GASM}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for organic fertilizers.	0.2
$EF_{f,direct}$	Emission factor for N additions from fertilizers, tonne N_2O-N / tonne N input.	0.010
MW_{N2O}	Molecular weight of N_2O.	44 g/mole
MW_N	Molecular weight of N.	14 g/mole

Equation 13: Fraction of Nitrogen that Volatilizes as NH_3 and NO_x for Synthetic Fertilizers

$$M_{SN} = \sum_f M_{SF_f} \times NC_{SF_f}$$

Where,

Parameter	Description	Default Value
M_{SN}	Mass of synthetic fertilizer nitrogen applied, tonnes of N during each Project Report Period.	N/A
M_{SFf}	Mass of synthetic fertilizer of type *f* applied in during each Project Report Period, measured in tonnes.	N/A
$NC_{SF,f}$	Nitrogen content (mass fraction) of synthetic fertilizer type *f* applied.	N/A

Equation 14: Fraction of Nitrogen that Volatilizes as NH_3 and NO_x for Organic Fertilizers

$$M_{ON} = \sum_v M_{OF_v} \times NC_{OF_v}$$

Where,

Parameter	Description	Default Value

M_{ON}	Mass of organic fertilizer nitrogen applied, tonnes of N in each Project Report Period.	N/A
M_{OFv}	Mass of organic fertilizer of type *v* applied in each Project Report Period, measured in tonnes.	N/A
NC_{OFv}	Nitrogen content (mass fraction) of organic fertilizer type *v* applied.	N/A

Project Proponents must identify the nitrogen content for each synthetic and organic fertilizer applied, as reported by the fertilizer manufacturer or determined by laboratory analysis.

Indirect N_2O Emissions

Indirect nitrous oxide Emissions from nitrogen fertilization are estimated using the following equations:

Equation 15: Indirect Fertilizer Use Emissions

$$N_2O_{indirect} = \left(N_2O_{(ATD)} + N_2O_{(L)}\right) \times \frac{MW_{N_2O}}{MW_N}$$

Where,

Parameter	Description	Default Value
$N_2Oindirect$	Indirect Emissions of N_2O as a result of nitrogen application within the Project Site during each Project Report Period.	N/A
$N_2O_{(ATD)}$	Amount of N_2O-N produced from atmospheric deposition of N volatilized, tonnes of N_2O in each Project Report Period. Determined using Equation 16.	N/A
$N_2O_{(L)}$	Amount of N_2O-N produced from leachate and runoff of N, tonnes of NO_2 in each Project Report Period. Determined using Equation 17.	N/A
MW_{N2O}	Molecular weight of N_2O.	44 g/mole
MW_N	Molecular weight of N.	14 g/mole

Equation 16: Amount of N_2O-N Produced from Atmospheric Deposition of N Volatilized

$$N_2O_{(ATD)} = [F_{SN} \times (Frac_{GASF}) + F_{ON} \times (Frac_{GASM})] \times EF_{ATD}$$

Where,

Parameter	Description	Default Value
$N_2O_{(ATD)}$	Amount of N_2O-N produced from atmospheric deposition of N volatilized, tonnes of NO_2 in each Project Report Period.	N/A
M_{SN}	Mass of synthetic fertilizer nitrogen applied, tonnes of N during each Project Report Period. Determined using Equation 13.	N/A
$Frac_{GASF}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for synthetic fertilizers.	0.1
M_{ON}	Mass of organic fertilizer nitrogen applied, tonnes of N in each Project Report Period. Determined using Equation 14.	N/A

$Frac_{GASM}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for organic fertilizers.	0.2
EF_{ATD}	Emission Factor for N_2O Emissions from atmospheric deposition of N on soils and water surfaces, tonne N_2O-N / tonne N input.	0.01

Equation 17: Amount of N_2O-N Produced from Leachate and Runoff of N

$$N_2O_{(L)} = ([F_{SN} + F_{ON}) \times Frac_{LEACH-(H)} \times EF_{(L)}$$

Where,

Parameter	Description	Default Value
$N_2O_{(L)}$	Amount of N_2O-N produced from leachate and runoff of N, tonnes of NO_2 in each Project Report Period.	N/A
M_{SN}	Mass of synthetic fertilizer nitrogen applied, tonnes of N in each Project Report Period. Determined using Equation 13.	N/A
M_{ON}	Mass of organic fertilizer nitrogen applied, tonnes of N in each Project Report Period. Determined using Equation 14.	N/A
$Frac_{LEACH-(H)}$	Fraction of N lost by leaching and runoff.	0.30 or 0 (see note)
$EF_{(L)}$	Emission factor for N_2O-N Emissions from N leaching and runoff, tonne of N_2O / tonne N input.	0.0075

The fraction of nitrogen lost by leaching and runoff ($Frac_{LEACH-H}$) applies only in those cases where soil water-holding capacity is exceeded as a result of precipitation or irrigation (i.e. precipitation is greater than evapotranspiration). Where this condition exists, the default value for $Frac_{LEACH-H}$ = 0.30. Where evapotranspiration is greater than precipitation, the value for this parameter is zero.

Project Proponents for each calculation must identify the nitrogen content for each synthetic and organic fertilizer applied, as reported by the fertilizer manufacturer or determined by laboratory analysis.

8.1.5 PE3 Biomass Combustion

Emissions from controlled burning of Biomass on-site, including burning of wood residuals and controlled burning for land clearing, and downstream manufacturing, etc., are to be determined using Equation 18.

Equation 18: PE3 Biomass Combustion

$$T_{PE3} = \sum_{b} EF_b \times AL_b \times CF_b$$

Where,

Parameter	Description	Default Value
T_{PE3}	Emissions from PE3 from Biomass combustion within the Project Site and downstream during each Project Report Period (tCO_2e).	N/A
EF_b	Emission factor for Biomass type *b* (e.g. tonnes CH_4, CO_2, and N_2O per tonne of Biomass burned).	See below
AL_b	Quantity of Biomass of type *b* combusted during each Project Report Period.	N/A
CF_b	Conversion factor to be used if the units of the activity level do not match those of the Emission factor for a particular Biomass type *b*. Note, special care must be taken to ensure that if the Emission factor and activity level do not assume the same moisture content of Biomass (often dry mass is assumed for Emission factors), an appropriate conversion factor is used based on measured or conservatively assumed Biomass moisture content. Where both the activity level and Emission factor are expressed in the same units, CF would be set to 1.	N/A

Determining the activity level

Project Proponents must propose and justify an approach for determining the total mass of Biomass combusted during controlled burning events during a reporting period. The guidance given in Approach B in the VCS Module VMD0031, Estimation of Emissions from Burning should be used as a basis for developing a method. It is expected that such a method will be tailored to the standard operating practices of the Project Proponent. It must be possible to verifiably demonstrate that the method results in a conservative estimate of associated Project Emissions as compared to Baseline Emissions. Wherever possible, measured amounts of Biomass should be used (e.g. mass or volume of Biomass combusted), though it is recognized that in many cases (e.g. land clearing) such a measurement may not be possible and estimates based on site observations will be necessary.

The Project Proponent may either use monitored data or may estimate the amount of HWP produced using monitored quantities of wood sent to the processing facility and a B.C.-specific default production loss factor of 41%.

Determining the Emission factor

Some Biomass combustion Emission factors are available in the WCI 2011 Quantification Methodologies and must be used so long as the Emission factor selected is appropriate for the type of Biomass and conditions under which it is being combusted. Otherwise, Emission factors found in peer reviewed Sources relevant to the Project Site conditions may be used. Where more site specific data is not available, values from the Intergovernmental Panel on Climate Change

Good Practice Guidance for Land Use, Land Use Change, and Forestry (Table 3A.1.16) (see Appendix B: References) may be used. Where figures from Table 3A.1.16 are used, they must be divided by 1000, to adjust the results from units of g/kg to units of t/t.

8.2 BASELINE EMISSIONS AND REMOVALS

Project Emission Reductions and Removal Enhancements are determined with Equation 19.

Equation 19: Total Baseline Emission Reductions or Removal Enhancements

$$\Delta GHG_{Baseline} = T_{(BR1\ to\ BR7)} + T_{BR8} - T_{BE1} - T_{BE2} - T_{BE3}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{Baseline,t}$	Total Emissions or Removals of CO_2e occurring in the Baseline during Project Report Period *t* (*tCO_2e*).	N/A
$\Delta T_{(BR1\ to\ BR7)}$	Emissions and Removals by Baseline live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined in Section 0.	N/A
T_{BR8}	Mass of CO_2 stored in Baseline HWPs up to time since the last Project Report Period (tCO_2e). Determined in Section 8.2.2.	N/A
T_{BE1}	Emissions from BE1 from fertilizer production that will be applied during each Project Report Period (tCO_2e). Determined in Section 8.2.3.	N/A
T_{BE2}	Emissions from BE2 as a result of nitrogen application within the Project Site during each Project Report Period(tCO_2e). Determined in Section 8.2.4.	N/A
T_{BE3}	Emissions from BE3 from Biomass combustion during each Project Report Period (tCO_2e). Determined in Section 8.2.5.	N/A

8.2.1 BR1 to BR7 Live and Dead Forest Carbon Reservoirs (Excluding HWP)

See Quantification Methodology for PR1 to PR7 in Section 7.0.

Estimating Harvest Flow

The Project Proponent must use the same method as the Project Scenario to estimate harvest flow as described in Section 8.1.1.2.

8.2.2 BR8 Harvested Wood Products In-Use

See Quantification Methodology for PR8 in Section 8.1.2.

Determining an Activity Level

In determining *RWBiomass*$_d$, for the Baseline Scenario, for species that are also harvested in the Project, the assumed HWPs produced from a given species must be the same as for the Project. For species harvested in the Baseline Scenario but not the Project, the Project Proponent must conservatively select and justify the HWPs produced from those species. Where the primary HWP produced cannot be identified for the Baseline Scenario, the HWP with the greatest overall storage in-use must conservatively be assumed.

8.2.3 BE1 Fertilizer Production

See Quantification Methodology for PE1 in Section 8.1.3.

Determining the activity level

Baseline fertilizer application must be estimated based on a justified application rate based on the practices described for the selected Baseline Scenario.

8.2.4 BE2 Fertilizer Use Emissions

See Quantification Methodology for PE2 in Section 8.1.4.

Determining the activity level

Baseline fertilizer application must be estimated based on a justified application rate based on the practices described for the selected Baseline Scenario.

8.2.5 BE3 Biomass Combustion

See Quantification Methodology for PE3 in Section 8.1.5.

Determining the activity level
It must be possible to verifiably demonstrate that the method results in a conservative estimate of Baseline Emissions. Wherever possible, measured amounts of Biomass should be used (e.g. mass or volume of Biomass combusted), though it is recognized that in many cases (e.g. land clearing) such a measurement may not be possible and estimates based on site observations will be necessary.

8.3 LEAKAGE

Leakage occurs when net increases in GHG Emissions occur outside the Project Site, as a result of the project activity.

Where a risk of Leakage exists, Project Proponents may undertake Leakage mitigation measures to reduce Leakage. If any significant increase in Emissions occurs as a result of these measures, the resulting Emissions must be accounted using the methods given in Section 0 for the appropriate Emission Source.

There are two potentially relevant forms of Leakage that must be assessed:

- L1 (Land Use-shifting Leakage), and
- L2 (Harvest-shifting Leakage).

Table 4 lists which Project types must assess which types of Leakage.

Table 4: Summary of potentially relevant Leakage types by Tenure type

Project Type	**Leakage Type**	
	Land Use Shifting	**Harvest-Shifting**
AFF/REF	Internal only	No
CONS/IFM	Yes	Yes if Project harvesting < Baseline harvesting
AC	Yes	Yes

Project Proponents will include a determination of Leakage in the Project Plan and Project Report.

8.3.1 L1 Land Use-shifting Leakage

Land Use-shifting Leakage (L1) is divided into two categories, and is determined with Equation 20:

1) Internal land use Leakage, and
2) External land use Leakage.

Equation 20: L1 Land use-shifting Emissions (Leakage)

$$L1 = GHG_{CO2,Internal\ Land\ Use\ Leakage} + GHG_{CO2,External\ Land\ Use\ Leakage}$$

Where,

Parameter	**Description**	**Default Value**
L1	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e).	N/A
$\Delta GHG_{CO2,\ Internal\ Land\ Use\ Leakage}$	Increase in Project Emissions due to internal deforestation during each Project Report Period (CO2e). Determined below.	N/A
$\Delta GHG_{CO2,\ External\ Land\ Use\ Leakage}$	Increase in Project Emissions due to external Land Use-shifting Leakage during each Project Report Period (tCO_2e). Determined below.	N/A

Determining $GHG_{CO2,\ Internal\ Land\ Use\ Leakage}$

Internal Land Use-shifting Leakage is deforestation shifting to other lands owned or controlled by the Project Proponent due to the Project.

Internal Land Use-shifting Leakage occurs where a Project Proponent decides to prevent the deforestation of a portion of their lands and establish CONS / IFM, and/or AC Project on those lands, while also deforesting another portion of land that they own, but which is outside the defined Project Site. Internal Land Use-shifting Leakage can also occur when part of a Project Proponents lands are afforested or reforested (AFF/REF), causing another part to be deforested.

Internal Land Use-shifting Leakage must be addressed by the Project Proponent as follows:

i. For AFF, CONS / IFM, and AC Projects; Internal Land Use-shifting Leakage may be assumed to be zero if one of the conditions a, b, or c apply:

   a. Lands controlled by the Project Proponent outside the Project Site are not Forest land,

   b. Covenants, easements, existing right of ways, or other restrictions are in place on all Forest lands controlled by the Project Proponent outside the Project Site for as long as those restrictions remain in place and to the extent that these restrictions demonstrate that Leakage is zero, and/or

   c. Demand for the land use that may cause Leakage in the Baseline Scenario is satisfied or removed or due to the actions of the Project Proponent (it is possible that a Project Proponent will not be able to demonstrate this initially but may be able to do so at some point during the Project).

ii. Otherwise, justify an appropriate geographic area for assessment of Land Use-shifting Leakage, considering economic and other relevant factors affecting demand for land-use types in the Baseline Scenario affected by the Project, given that land use demand is typically local in nature (e.g. demand for housing, commercial land, etc.). A Project Proponent may skip this step by including all land that they own or control within the assessment area.

In each Project Report, the Project Proponent must report on any deforestation activities that have occurred within the assessment-area and where the Project Proponent owns or controls the land, where the new land use is equivalent to the Project's land use in the Baseline Scenario. Where such deforestation is identified, the decrease in stored carbon that occurs as a result of the deforestation, must be assessed using Equation 21. Net decreases associated with that deforestation activity must be recorded as an affected land use shifting Emission for the Project.
Internal Land Use Leakage is equal to the net decrease in forest carbon Reservoirs due to deforestation lands owned or controlled by the Project Proponent, as indicated in Equation 21.

Equation 21: Internal Land Use Leakage*GHG*$_{CO2,\ Internal\ Land\ Use\ Leakage}$

$$\Delta GHG_{CO2,Internal\ Land\ Use\ Leakage} = \left(\Delta T_{(DR1\ to\ DR7)}\right) - \left(\Delta T_{(NDR1\ to\ NDR7)}\right)$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{CO2,Internal\ Land\ Use\ Leakage}$	Total increase in Project Emissions due to internal deforestation during each Project Report Period(CO_2e).	N/A
$\Delta T_{DR1\ to\ DR7}$	Emissions due to deforestation by live and dead forest carbon Reservoirs (excluding HWPs) (tCO_2e). Determined similar to Equation 3 for the Project. For the end of each Project Report Period.	N/A
$\Delta T_{NDR1\ to\ NDR7}$	Non-deforested Emissions and Removals by live and dead forest carbon Reservoirs (excluding HWPs) (tCO_2e). Determined similar to Section 0 for the Baseline. For the end of each Project Report Period.	N/A

Determining GHG$_{CO2,\ External\ Land\ Use\ Leakage}$

External Land Use-shifting Leakage is deforestation of lands outside the ownership or control of the Project Proponent due to the Project. External land use Leakage only needs to be addressed for AC Projects as follows:

i. External land use Leakage may be assumed to be zero if it can be verifiably shown that demand for the land use in the Baseline Scenario is satisfied or removed in some way by or due to the actions of the Project Proponent that does not lead to deforestation outside of the Project Site.

ii. Otherwise, using the Local Study Area for assessment (see Section 4.04.2), considering economic and other relevant factors affecting demand for land-use types in the Baseline Scenario affected by the Project, given that land use demand is typically local in nature (e.g. demand for housing, commercial land, etc.).

A Leakage-assessment must consider, at minimum, the following:

- The state of supply and demand for the land use in the Baseline Scenario type, including historic trends over the past 5 years, the current situation, and a projection forward of anticipated future trends over the Project's Project Crediting Period (25 years as per the Regulation),
- All local zoning bylaws and other restrictions on land development such as covenants, easements, and existing right of ways,
- Community development plans and regional growth strategies,
- There are restrictions in place such that there is no opportunity for the land use in the Baseline Scenario to shift to other Forest land within the Leakage-assessment-area. Consequently, the demand for land will remain unfilled (note, zoning restrictions are likely not sufficient to demonstrate this, as zonings may be changed based on applications by developers, and land use plans), and
- Availability of Forest land (private, municipal, Crown-owned, First Nations, reserves, or other) that might be suitable for the land use in the Baseline Scenario, subject to the above assessment of zoning, plans and strategies, but with consideration of the potential for zoning changes to occur that might permit

additional Forest lands to be eligible for deforestation and conversion to the land use in the Baseline Scenario type.

The External Land Use-Shifting Leakage assessment must be prepared by a Designated Member of the Appraisal Institute of Canada and must accompany an assessment of the suitability of the land for the conversion required in Section 3.2.3.

> *Guidance Note: The use of average development rates for lands over a broad geographic area (e.g. all of B.C.) will not be appropriate for assessing Leakage, as by definition, a AC Project is occurring in an area of sufficient non-Forest land use demand that the deforestation Baseline can be justified. It is likely that local land use demand will exceed average land use demand across a broader area.*

Based on the results of this assessment, the Project Proponent must verifiably provide a conservative assessment of the quantity of Emissions that would occur from affected carbon Reservoirs, based on the per hectare Removals to be achieved by the Project from forest carbon Reservoirs relative to the Baseline Scenario over the Project Crediting Period in Equation 22. The deforested hectares developed must reflect that assessed likelihood / risk that Leakage might occur.

Equation 22: Net decrease in forest carbon Reservoirs due to deforestation lands not owned or controlled by the Project Proponent

$$\Delta GHG_{CO2,External\ Land\ Use-shifting\ Leakage,} = \frac{\left(\Delta T_{(PR1\ to\ PR7)}\right) - \left(\Delta T_{(BR1\ to\ BR7)}\right)}{Ha_{Project\ Site}} \times Ha_{deforested\ hectares}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{CO2,\ External\ Land\ Use\text{-}shifting\ Leakage}$	Net increase in Project Emissions due to external Land Use-shifting Leakage during each Project Report Period.	N/A
$\Delta T_{(PR1\ to\ PR7)}$	Emissions and Removals by Project live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined using Equation 4.	N/A
$\Delta T(_{BR1\ to\ BR7})$	Emissions and Removals by Baseline live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO2e). Determined in Section 0.	N/A
$Ha_{Project\ Site}$	Area of the AC Project (ha).	N/A
$Ha_{Deforested\ hectares}$	Area of deforestation expected outside the Project Site and not owned or controlled by the Project Proponent in each Project Report Period.	N/A

8.3.2 L2 Harvest-shifting Leakage

Harvest Leakage occurs when there is an increase in GHG Emissions from areas outside the Project Site, which occurs as a result of the Project reducing production of a commodity, causing a change in the supply and market demand equilibrium, resulting in a shift of production elsewhere to make up for the lost supply.

For Projects that are required to assess both Land Use-shifting Leakage and Harvest-shifting Leakage, Land Use-shifting Leakage must be assessed first. Harvest-Shifting Leakage is to be assessed based only on the amount of decreased Project harvesting relative to the Baseline Scenario that is not already accounted for by Land Use-shifting Leakage.

Harvest-shifting Leakage must only be assessed in a given Project Report Period where Project HWP production, in terms of amount of carbon or carbon dioxide stored, is less than HWP production in the Baseline Scenario. Where HWP production in the Baseline Scenario is zero (e.g. typically in AFF/REF Projects), Harvest-shifting Leakage would be zero. In AC Projects, the Baseline Scenario include harvesting until the lands in the Baseline Scenario have been fully developed and further deforestation ceases.

AC Projects with the potential for both Land Use-shifting and Harvest-shifting Leakage, Harvest-shifting Leakage is to be assessed based only on the amount of decreased Project harvesting relative to the Baseline Scenario that is not already represented in the assessed amount of Land Use-shifting Leakage. For example, if half of the deforestation in the Baseline Scenario avoided by a Project at the Project Site is determined to shift to other areas outside of the Project due to non-Forest land use demand, Harvest-shifting Leakage would only be assessed on the portion of AC (i.e. avoided harvesting) that would not have shifted to other areas due to non-Forest land use demand. For internal Harvest-shifting Leakage, this must be factored into the analysis conducted by the Project Proponent, External Harvest-shifting Leakage has been explicitly factored into the equations provided below.

Two options are available for Project Proponents to determine Harvest-shifting Leakage; assessing the total change in carbon all Reservoirs, or assessing the total change in harvesting in affected Reservoirs. The estimate approach may not be revised once established in the Project Plan.

8.3.2.1 Harvest-shifting Leakage (Option 1 – Change in Forest Carbon Reservoirs)

This approach uses the total change in forest carbon Reservoirs in a Project Report Period, rather than just the change associated with harvesting, as the basis for the external harvesting Leakage calculation. This approach is most suitable for Projects that reduce the amount of harvesting relative to the Baseline Scenario without undertaking any other changes to forest management practices.

Equation 23: Total Harvest Shifting Emissions (Leakage) – Option 1

$$L2_{option1} = max\{0, \Delta GHG_{CO2,R} + \Delta GHG_{CO2,R\ HWP} - L1\} \times \%Leakage_{External\ Harvest\ Shifting}$$

Where,

Parameter	Description	Default Value
$L2_{option1}$	Net increase in Project Emissions due to Harvest-shifting Leakage from all affected carbon Reservoirs during each Project Report Period(tCO2e).	N/A
$\Delta GHG_{CO2,R}$	Net incremental mass of CO_2e stored by the Project in forest carbon Reservoirs *R* (excluding HWPs) during each Project Report Period as compared to the Baseline Scenario (tCO_2e). Determined using Equation 24.	N/A
$\Delta GHG_{CO2,R,HWP}$	Net incremental mass of carbon dioxide stored in Project Reservoir *R* HWPs harvested during each Project Report Period that will endure for a period of 100 years as compared to the Baseline Scenario (tCO_2e). Determined using Equation 25.	N/A
L1	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined using Equation 20.	N/A
$\%Leakage_{External\ Harvest\text{-}Shifting}$	Increase in Project Emissions due to external Harvest-shifting Leakage during each Project Report Period, expressed as a percentage of the net Removals that is expected to shift to lands outside the ownership or control of the Project Proponent over the Project Report Period. See Section 8.3.2.3.1 or Section 8.3.2.3.2 below.	N/A

Equation 24: Net incremental Project carbon dioxide stored in forest carbon Reservoirs (excluding HWPs)

$$\Delta GHG_{CO2,R} = \sum (\Delta T_{(PR1\ to\ PR7)} - \Delta T_{(BR1\ to\ BR7)})$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{CO2,R}$	Net incremental mass of CO_2e stored by the Project in forest carbon Reservoirs *R* (excluding HWPs) during each Project Report Period as compared to the Baseline Scenario (tCO_2e).	N/A
$\Delta T_{(PR1\ to\ PR7)}$	Emissions and Removals by Project live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined using Equation 4.	N/A
$\Delta T_{(BR1\ to\ BR7)}$	Emissions and Removals by Baseline live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO2e). Determined in Section 0.	N/A

Equation 25: Net incremental Project carbon dioxide stored only in Harvested Wood Products

$$\Delta GHG_{CO_2,R,HWP} = \sum (T_{PR8} - T_{BR8})$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{CO2,R,HWP}$	Net incremental mass of CO_2 stored in Project Reservoir *R* HWPs harvested during each Project Report Period that will endure for a period of 100 years as compared to the Baseline Scenario (tCO_2e).	N/A
T_{PR8}	Mass of CO_2 stored in Project HWPs during each Project Report Period (tCO_2e). Determined using Equation 7.	N/A
T_{BR8}	Mass of CO_2 stored in Baseline HWPs during each Project Report Period (tCO_2e). Determined in Section 8.2.2.	N/A

Determining External Harvest-shifting Leakage factor ($\%Leakage_{External\ Harvest\text{-}Shifting}$)

See Section 8.3.2.3.

8.3.2.2 Harvest-shifting Leakage (Option 2 – Harvesting only)

Option 2 uses changes in forest carbon Reservoirs related to harvesting only, rather than the total change in forest carbon Reservoirs, as the basis for the external harvesting Leakage calculation.

Guidance Note: If a Project contains activities that increase carbon stocks through harvest reduction and silviculture activities, Harvest-shifting Leakage would be determined solely on the reduction of carbon stocks resulting from harvest reduction.

Equation 26: Total Harvest-shifting Leakage – Option 2

$$TL2_{option2} = GHG_{CO2,Internal\ Harvest-shifting} + max\{0, \Delta GHG_{CO_2,Harvesting,} + \Delta GHG_{CO_2,R\ HWP} - GHG_{CO_2,Internal\ Harvest-shifting} - L1\} \times \%Leakage_{External\ Harvest-shifting}$$

Where,

Parameter	Description	Default Value
$L2_{option2}$	Net increase in Project Emissions due to Harvest-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e).	N/A
$\Delta GHG_{CO2,Internal\ Harvest-shifting}$	Increase in Project Emissions due to internal Harvest-shifting Leakage during each Project Report Period. See below.	N/A
$\Delta GHG_{CO2,Harvesting}$	Net incremental mass of CO_2 removed from the Project forest during each Project Report Period compared to the Baseline Scenario (tCO_2e), via the following mechanisms: • Physical Removal of harvested wood from the Project forest. • Harvesting-related losses that occur within the forest (e.g. lost branches, tops, etc.) that are assumed to rapidly decay and release CO_2 to the atmosphere. • Biomass combustion. Determined using Equation 27.	N/A
$\Delta GHG_{CO2,R,HWP}$	Net incremental mass of CO_2 stored in Project Reservoir *R* HWPs harvested during each Project Report Period that will endure for a period of 100 years as compared to the Baseline Scenario (tCO_2e). Determined using Equation 25.	N/A
L1	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO2e). Determined using Equation 20.	N/A
$\%Leakage_{External\ Harvest-shifting}$	Increase in Project Emissions due to external Harvest-shifting Leakage during each Project Report Period, expressed as a percentage of the net Removals that is expected to shift to lands outside the ownership or control of the Project Proponent over the Project Report Period. See Section 8.3.2.3.1 or Section 8.3.2.3.2 below.	N/A

As with Land Use-shifting Leakage, Harvest-shifting Leakage is divided into two categories: Internal Harvest-shifting Leakage and External Harvest-shifting Leakage

Determining Internal Harvest-shifting Leakage (*$GHG_{CO2,\ Internal\ Harvest-shifting}$*)

Internal Harvest-shifting Leakage refers to the shifting to other lands owned or controlled by the Project Proponent.

Internal Harvest-shifting occurs where a Project Proponent decides to reduce harvesting on a portion of their lands and establish a Project while increasing harvesting on another portion of land that they own, but which is outside the defined Project Site.

Internal Harvest-shifting Leakage is to be addressed by the Project Proponent in each Project Report Period as follows:

i. If it can be verifiably shown that demand for harvested wood that is no longer harvested by the Project is satisfied or removed in some way by or due to the actions of the Project Proponent, then Internal Harvest-shifting Leakage can be assumed to be zero for the remainder of the Project (it is possible that a Project Proponent will not be able to demonstrate this initially but may be able to do so at some point during the Project).
ii. Assess the opportunities for increasing harvesting on other lands owned or controlled by the Project Proponent by:
    a. For Crown land licensed by the Project Proponent, report on the difference between current harvesting levels and the annual allowable cut in all Timber Supply Areas (TSAs) and Tree Farm Licence (TFL) areas for which the Project Proponent holds a license. In the case of TSAs, this may require the consideration of land not controlled by the Project Proponent, but that still falls within a TSA in which the Project Proponent holds a license (for the purposes of this Internal Harvest-shifting Leakage assessment, such lands will be considered owned or controlled).
    b. For private land, assess the extent to which other Forest land owned or controlled by the Project Proponent could be harvested (which could consider the existence of land covenants that would prohibit harvesting).

If there are no opportunities for further harvesting identified, then Internal Harvest-shifting Leakage may be assumed to be zero.

iii. If opportunities for increased harvest are identified, then the Project Proponent has two options:
    a. Expand the Project Site to encompass areas with additional harvesting potential, thereby bringing all potential Sources of Internal Harvest-shifting Leakage within the controlled SSRs of the Project, and assume Internal Harvest-shifting Leakage is zero, or
    b. Prepare a report that assesses the extent to which internal Harvest-shifting Leakage has occurred, by considering historic harvesting amounts per hectare per year on all owned and controlled lands outside of the Project Site for the 5 years prior to the start of the current Project Report Period and all years within the current Project Report Period as well as regional or provincial trends in amounts of harvesting over the same timeframe (with the selected geographic area to be justified by the Project Proponent). Where owned and controlled harvesting trends indicate that harvesting has increased relative to regional or provincial trends, and where these increases cannot be explained by factors independent from the Project, Internal Harvest-shifting Leakage is to be assessed as the minimum of:
        - The difference between owned and controlled harvesting per hectare per year and regional or provincial harvesting per hectare per year multiplied by the total hectares of owned and controlled forest outside of the Project Site and by the number of years in the Project Report Period,
        - The maximum potential amount of increased harvesting that could occur over the Project Report Period based on the assessment described in ii.a., above, and,
        - The total amount of decreased harvesting that occurred due to the Project relative to the Baseline during the current reporting period plus decreases in harvesting between the Project and Baseline for the five years prior to the start of the current reporting period minus any internal Harvest-shifting Leakage assessed against the Project due to decreased harvesting in the five years prior to the start of the current reporting period.

Equation 27: In-forest harvesting impacts (for Harvest-shifting Leakage Option 2)

$$\Delta GHG_{CO2,Harvesting} = \left[\sum_{s} \left(M_{s,baseline} \div Harvest\ Efficiency_{s} \right) - \sum_{s} \left(M_{s,project} \div Harvest\ Efficiency_{s} \right) \right] \times f_{C,wood} \times \frac{MW_{CO_2}}{MW_C}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{CO2,Harvesting}$	Net incremental mass of CO_2 removed from the Project forest during each Project Report Period as compared to the Baseline Scenario, via the following mechanisms: • Physical Removal of harvested wood from the Project forest. • Harvesting-related losses that occur within the forest (e.g. lost branches, tops, etc.) that are assumed to rapidly decay and release CO2 to the atmosphere. • Biomass combustion.	N/A
$M_{s,Baseline}$	Dry mass of harvested wood, minus bark, harvested in the Baseline during each Project Report Period that will be processed into HWP. Measured in tonnes dry Biomass. This value is determined in a manner analogous to $RWBiomass_d$ in Equation 9, except that this mass is determined by species rather than by HWP type.	N/A
$Harvest\ Efficiency_s$	The ratio of $M_{s,Baseline}$ to total woody dry mass of a tree of species *s* prior to harvest. See below.	See below.
$M_{s,Project}$	Dry mass of harvested wood, minus bark, harvested in the Project during each Project Report Period that will be processed into HWP. Measured in tonnes dry Biomass. This value is determined in a manner analogous to $RWBiomass_d$ in Equation 9, except that this mass is determined by species rather than by HWP type.	N/A
$f_{C,wood}$	Fraction of the dry mass of wood, excluding bark, that is carbon.	Assumed to be 50% for all wood species.
MW_{CO_2}	Molecular weight of CO_2.	44 g/mole
MW_C	Molecular weight of carbon.	12 g/mole
s	Relevant tree species types being harvested in the Project and Baseline area.	N/A

Determining Harvest Efficiency$_s$

The Project Proponent will be responsible for justifying harvesting efficiencies appropriate for the Project and Baseline Scenario.

Harvesting efficiency is determined by considering tree species (*s*) involved, typical age of trees at harvest, and any other relevant factors. A Project Proponent may choose to use a single harvest efficiency value, rather than one for each relevant species, as long as the approach is demonstrated to be conservative (i.e. does not under-estimate Leakage).

External Harvest-shifting Leakage ($\%Leakage_{\text{External Harvest-shifting}}$)

External Harvest-shifting Leakage refers to the shifting to other lands outside the ownership or control of the Project Proponent.

If it can be verifiably shown that demand for wood products that are no longer produced by the Project relative to the Baseline Scenario during the Project Report Period is satisfied or removed in some way by or due to the actions of the Project Proponent that does not involve increasing harvesting outside the Project Site, then External Harvest-shifting Leakage may be assumed to be zero for that Project Report Period. Otherwise, External Harvest-shifting Leakage must be assessed in a manner consistent with Section 8.3.2.1.

8.3.2.3 External Harvest-Shifting Leakage

To determine the external harvesting-shifting Leakage factor, two options are provided:

1) Provincial default Leakage factor estimates (Option 1), and
2) Project-specific external Harvest-shifting Leakage factor (Option 2)

A Project Proponent may use either approach (subject to any restrictions noted below). However, where a Project Proponent decides part way through the Project to change from the use of a Project-specific approach to the use of provincial default estimates and such a change is likely to result in a lower assessed amount of Leakage going forward, the Project Proponent must estimate the extent to which the default value underestimates Leakage relative to the Project-specific case based on historic Project data and provincial default estimates, and adjust the provincial default results going forward accordingly to minimize the likelihood of the final Leakage assessment underestimate what the Project-specific approach would have likely determined. The Project Proponent must also consider if, and to what degree, the historic Project-specific approach overestimated actual historic Leakage based on retroactive market and other data, and adjust the estimate accordingly.

8.3.2.3.1 Provincial default external Harvest-shifting Leakage estimates

The Project Proponent may use provincial default Leakage estimate from Table 5 below for their Project Leakage estimate provided that the value is supported by a statement of acceptance that the Project is representative of average timber commodities and the Project Proponent has no reason to believe Leakage would be higher than the provincial default Leakage estimate.

Table 5: Provincial default external Harvest-shifting Leakage estimates ($\%Leakage_{\text{External Harvest-Shifting}}$)

Geographic Area	Estimated Leakage
Northern Interior	71.89%
Southern Interior	69.18%
Coast	47.37%

The default Leakage factors referenced in the above table have been derived using the Project-specific approach based on the average mix of tree species in the total harvest of each respective geographic area (see Appendix C: Project-specific external Harvest-Shifting Leakage Determination). There are certain tree species in specific regions of B.C., which are less substitutable in terms of developing certain wood products than others. The substitutability of wood products has a significant effect on the ultimate Leakage estimate. The Project Proponent should use the provincial default Leakage estimates as a guide. When Project Sites have proportions of tree species that differ from the default averages and perhaps higher proportions of tree species with low or moderate substitutability than what is reflected in the default for the Project's Site, it is recommended that the Project Proponent utilize the guidance indicated in this document adjust the Leakage estimates to reflect these Project Specifics accordingly.

8.3.2.3.2 Project-specific external Harvest-shifting Leakage estimates

The Project Proponent may estimate Project Specific Leakage rates using the methodology in Appendix C: Project-specific external Harvest-Shifting Leakage Determination.

8.4 REVERSALS AND THE CONTINGENCY ACCOUNT

The Regulation requires that the Project Proponent of sequestration Projects ensure that the Project Removals remain Permanently sequestered. For the purposes of this Protocol, 100 years after the Crediting Period ends is considered Permanent.

Other agreements in addition to this Protocol (i.e. Atmospheric Benefit Agreements or Atmospheric Benefit Sharing Agreements) with government may require additional deductions (see Equation 1).

8.4.1 Monitoring and Maintenance Plan for Reversals during and after the Project

Project Proponents must provide a Monitoring and Maintenance Plan which (along with data collection considerations included in Section 10.0) includes descriptions on how Risk of Reversal will be managed throughout the Crediting Period and Monitoring Period.

In addition to the identification of each risk below, the Project Proponent must document how each risk will be monitored, mitigated (if applicable - see Appendix H) and reported on in a time period consistent with the Project Report Periods and Monitoring Periods:

- Financial risk
- Fire risk
- Drought risk
- Pest and disease risk
- Wind risk
- Hydrological or flooding risks
- Geomorphic and/or geological risks

Assumptions used to inform the Monitoring and Maintenance Plan must use peer-reviewed research, government publications (from the Government of Canada or Government of B.C.), or data from within 10 years.

Reversal Monitoring must be described in detail as part of the Project design and Project Monitoring procedures in the Project Plan.

8.4.2 Identifying a Reversal

Reversals are a decrease in the Project Reservoir whereby the amount of Emissions released exceeds the number of Removal Enhancements that occur when carbon stocks associated with issued Offset Units are released to the atmosphere in a Project Report Period. In other words, a Reversal is a disturbance where the sum of the selected SSRs including Leakage under Baseline and Project Scenarios is negative. The Project Proponent must demonstrate through verification, that carbon stocks associated with previously issued Offset Units from Emission Reductions or Removal Enhancements are maintained for 100 years.

Reversals occur where there has been a loss of forest carbon stocks, i.e., a release to the atmosphere of carbon dioxide, that was not included as part of the Emissions modeling, across the Project Site as opposed to a stand-by-stand basis. Reversals may also occur in cases where the Project Proponent was negligent in their Project responsibilities that led to the Reversals, e.g., not adhering to the Monitoring requirements of the Project Plan. Reversals as a result of provincial government decision-making on Crown land are not considered Reversals, and are instead handled through negotiated contracts between the Crown and the Project Proponent.

Disturbances and harvesting that are anticipated to occur on a predictable basis for the project area shall be included within the modeling of the Project and Baseline. Where harvesting in a Project Report Period exceeds Baseline harvesting in that same period, a Reversal has occurred.

Reversals can be caused by wildfire, disease/insects, third party illegal harvesting beyond the control of the Project Proponent e.g. theft, or any other event that were caused by natural, unintended forces. Forests are subject to a variety of natural disturbances that reduce growth and carbon storage. The Risk of Reversal is determined in Appendix H: Risk of Reversal Determination.

Changes to assumptions of climate variability, which was built into original modelling, but was revised throughout Project Reporting periods will see retirements of units from the Contingency Account should a material loss of the Primary Activity Reservoir occur.

8.4.3 During Project Crediting Period

8.4.3.1 Notifying of a Reversal

For all Reversals, the Project Proponent must notify the Director, in writing, of the Reversal and provide a description and the nature of the Reversal within 30 calendar days of its discovery.

8.4.3.2 Reporting of a Reversal

Project Proponents that have identified an event meets the definition of a Reversal must complete the Reversal Report Appendix on the Government-approved Project Report template at each Project Report Period.

8.4.3.3 Verifying Reversal Determination

The Project Proponent must itemize all Reversals in the Project Report. Assessment of the impact of a Reversal must be consistent with the same field sampling, modeling, and/or quantification procedures employed by the Project for assessing Project and Baseline Emissions and Removal Enhancements.

8.4.3.4 Project and Baseline Scenario Adjustments

Once a Reversal occurs, the Project and Baseline Scenarios must be adjusted for subsequent Project Reports. Furthermore, Offset Units may not be claimed resulting from sequestration from natural regeneration

The impact of the Reversal on forest carbon must, in addition to being assessed for the Project, also be modeled for the Baseline Scenario (except where the Baseline is non-Forest land such as in AFF or AC where the Project Site is non-forest at the start of the Crediting Period).

Modeling must include observations of the type and extent of Reversal experienced by the Project, as well as assumptions regarding the Baseline Scenario. In preparing the revised Baseline model, the Project Proponent must demonstrate in the Project Report how the model will provide a conservative estimate of the Baseline (i.e. does not overstate the impact of the Reversal on the Baseline) to manage the uncertainty of predicting the impact of a particular Reversal on a hypothetical Baseline Scenario.

8.4.4 After Project Crediting Period

The Project Proponent must follow the same approach as during the Project Crediting Period addressing a Reversal with the exception that reporting the Reversal(s) must occur at the next required Monitoring Report. More Monitoring Report requirements can be found in Section 10.1.

8.4.5 Contingency Account

8.4.5.1 Contributions to Contingency Account

To mitigate the risk of potential Reversals described in this section, Project Proponents are required to contribute a percentage of the net Removal Enhancements and Emission Reductions at each Offset Unit issuance to the B.C. Contingency Account.

8.4.5.1.1 Contingency Account Details

The B.C. Contingency Account is a holding account into which the Director issues Offset Units in accordance with Section 13(4)(c) of the *Act*. When issuing Offset Units based upon Project Reports and Verification Statements for forest carbon sequestration and storage Projects, the Director issues a specified volume of verified Offset Units into the Contingency Account to account for the Risk of Reversal. In accordance with the Regulation Section 24(2), up to 51% of the Offset Units issued in relation to a sequestration and storage Project may be required to be credited to the Contingency Account. Each sequestration or storage Project's contribution of Offset Units to the Contingency Account is determined, asserted and verified using a Risk of Reversal described in Section 8.4.5.2. If a Sequestration Project experiences a Reversal of an Emission Reduction and/or Removal Enhancement, the Director will retire from the Contingency Account a number of Offset Units equal to the amount that have been reversed. The purpose of the Contingency Account is to act as a form of insurance and to maintain environmental integrity of the program.

8.4.5.2 Risk of Reversal

The purpose of determining the Risk of Reversal of a Project is to determine the likelihood and magnitude that a Reversal will occur up to 100 years after the Crediting Period ends. The Risk of Reversal is based upon Project-specific attributes and must be determined using the approach described in Appendix H: Risk of Reversal Determination. Once established, the Risk of Reversal is multiplied against the Project Reductions to determine the portion of Offset Units that the Director will issue into the Contingency Account. See Equation 28 for more details.

Equation 28: Determining Contingency Account Remittance

$$CON_{\beta} = \beta \times [\Delta GHG_{net} - L1 - L2]$$

Where,

Parameter	**Description**	**Default Value**
CON_{β}	Contributions to the Contingency Account by the Project Proponent during each Project Reporting period. Expressed as tCO_2e.	N/A
β	Percentage of units contributed to the Contingency Account at each Project Report Period. Determined in Appendix H: Risk of Reversal Determination.	N/A
ΔGHG_{net}	Net incremental Emission Reductions and Removal Enhancements of CO_2e before deductions, achieved by the Project during the Project Report Period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number. Determined using Equation 2.	N/A
$L1$	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined using Equation 20.	N/A
$L2$	Net increase in Project Emissions due to Harvest-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined in Section 0.	

8.4.5.3 Compensating for a Reversal

The Contingency Account is designed to account for Reversals only. Upon submission of the Project Report or Monitoring Report and in the case where an Reversal has occurred, the Project Proponent must make a request to the Director to retire Offset Units held in the contingency account in an amount equal to the verified Reversal estimate in the Project Report or Monitoring Report. At the discretion of the Director, the Director may retire Offset Units in accordance with the Regulation.

The Director may also withhold future issuances Offset Units until the accepted number of Offset Units have been retired from the Contingency Account.
In the event that a Reversal occurs for a Project Instance within a PoA, the Project Proponent must make a request to the Director to retire Compliance Units held in the Contingency Account on behalf of all aggregated Project Instances.

8.4.5.4 Termination of a Project

If Reversals exceed the amount remitted to the Contingency Account over the Project to date, the number of offsets allocated in the Contingency Account for that Project reaches zero. In that instance, the Project is terminated. Depending on the Project type and the nature of the disturbance, a new Project may be established.

8.5 PROJECT REDUCTIONS

A summary of equations used to determine Emission Reductions and Removal Enhancements is below.

Total Project Emissions and Removal are determined as shown in Equation 3.

Equation 3: Total Project Emission Reductions or Removal Enhancements

$$\Delta GHG_{Project,t} = \Delta T_{(PR1\ to\ PR7)} + T_{PR8} - T_{PE1} - T_{PE2} - T_{PE3}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{Project,t}$	Total Emissions or Removals of CO_2e occurring in the Project during the Project Report Period *t* *(tCO_2e)*.	N/A
$\Delta T_{(PR1\ to\ PR7)}$	Emissions and Removals by Project live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined using Equation 4.	N/A
T_{PR8}	Mass of CO_2 stored in Project HWPs during each Project Report Period. Measured in tCO_2e. Determined using Equation 7.	N/A
T_{PE1}	Emissions from PE1 from fertilizer production that will be applied during each Project Report Period(tCO_2e). Determined using Equation 10.	N/A
T_{PE2}	Emissions from PE2 from nitrogen application within the Project Site during each Project Report Period (tCO_2e). Determined using Equation 11.	N/A
T_{PE3}	Emissions from PE3 from Biomass combustion within the Project Site and downstream during each Project Report Period (tCO_2e). Determined using Equation 18.	N/A

Total Baseline Emissions and Removal Enhancements are determined by using Equation 19.

Equation 19: Total Baseline Emission Reductions or Removal Enhancements

$$\Delta GHG_{Baseline,t} = T_{(BR1\ to\ BR7)} + T_{BR8} - T_{BE1} - T_{BE2} - T_{BE3}$$

Where,

Parameter	Description	Default Value
$\Delta GHG_{Baseline,t}$	Total Emissions or Removals of CO_2e occurring in the Baseline during Project Report Period *t* *(tCO_2e)*.	N/A
$\Delta T_{(BR1\ to\ BR7)}$	Emissions and Removals by Baseline live and dead forest carbon Reservoir (excluding HWPs) during each Project Report Period (tCO_2e). Determined in Section 0.	N/A
T_{BR8}	Mass of CO_2 stored in Baseline HWPs up to time since the last Project Report Period (tCO_2e). Determined in Section 8.2.2.	N/A
T_{BE1}	Emissions from BE1 from fertilizer production that will be applied during each Project Report Period(tCO_2e). Determined in Section 8.2.3.	N/A
T_{BE2}	Emissions from BE2 as a result of nitrogen application within the Project Site during each Project Report Period(tCO_2e). Determined in Section 8.2.4.	N/A
T_{BE3}	Emissions from BE3 from Biomass combustion during each Project Report Period(tCO_2e). Determined in Section 8.2.5.	N/A

Net Project Emissions Reduction and Removal Enhancements are determined as shown in Equation 2.

Equation 2: Net Project Emission Reductions and Removal Enhancements **Before Deductions**

$$\Delta GHG_{net} = \Delta GHG_{Project} - \Delta GHG_{Baseline}$$

Where,

Parameter	Description	Default Value
ΔGHG_{net}	Net incremental Emission Reductions and Removal Enhancements of CO_2e before deductions achieved by the Project during the Project Report Period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number.	N/A
$\Delta GHG_{Project,t}$	Total Emissions or Removals of CO_2e occurring in the Project during the Project Report Period *t* (tCO_2e). Determined using Equation 3.	N/A
$\Delta GHG_{Baseline,t}$	Total Emissions or Removals of CO_2e occurring in the Baseline during the Project Report Period *t* (tCO_2e). Determined using Equation 19.	N/A

Total net Project Emission Reductions and Removal Enhancements after deductions are determined as shown in Equation 1.

Equation 1: Net Project Emission Reductions and Removal Enhancements in CO2e

$$\Delta CO_2e_{net} = \Delta GHG_{net} - L1 - L2 - \mathrm{CON}_{\beta,} - Other\ deductions$$

Where,

Parameter	Description	Default Value
ΔCO_2e_{net}	Net Emission Reductions and Removal Enhancements of CO_2e, in tonnes, achieved by the Project Proponent during reporting period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number.	N/A
ΔGHG_{net}	Net incremental Emission Reductions and Removal Enhancements of CO_2e before deductions, achieved by the Project during the Project Report Period as compared to the Baseline (tCO_2e). A net increase in Emission Reductions and Removal Enhancements is expressed as a positive number. Determined using Equation 2.	N/A
L1	Net increase in Project Emissions due to Land Use-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined using Equation 20.	N/A
L2	Net increase in Project Emissions due to Harvest-shifting Leakage from all affected carbon Reservoirs during each Project Report Period (tCO_2e). Determined in Section 0.	N/A
CON_{β}	Contributions to the Contingency Account during each Project Report Period. Expressed as tCO_2e. Determined using Equation 28.	N/A
Other deductions	Other deductions established in an Atmospheric Benefits Agreement, Indigenous Atmospheric Benefit Agreement, Atmospheric Benefits Sharing Agreement, or other contractual obligations (if relevant) (tCO_2e).	N/A

9.0 PROJECT ESTIMATES

In accordance with Section 14(3)(l) of the Regulation, the Project Proponent in the Project Plan are required to:

- Estimate the expected Project Reductions to be achieved by the Project during its Crediting Period.
- Identify the basis on which the Project Emissions and Removals were estimated (14(3)(l)(i)).
- Identify the formulas that will be used to determine the Project Reduction for each Project Report Period (14(3)(l)(ii)).

For each SSR identified in the Project Plan, Project Proponents must justify the calculation methodology used for the Project Crediting Period and why the activity levels that were estimated are reasonable.

In the Project Plan, the Project Proponent must present these estimates of future Project Reductions for each Project Report Period for the for the entire Project Crediting Period.

10.0 Data Collection and Monitoring

In the Project Plan, the Project Proponents must detail their Monitoring and Maintenance plan in accordance with ISO 14064-2:2019 (sections 6.9 and 6.10), and record retention period established in the Regulation. The data collection and monitoring approach must be validated and followed throughout the Crediting Period and Monitoring Period.

For PoA Projects, some of the data or parameters may only available for aspects of the Project included at initial Validation. Project Instances added afterwards would be evaluated during the next Verification.

10.1 Monitoring Period

The Regulation stipulates a 100 year Monitoring Period for Sequestration Projects.

Monitoring Reports are required from the Project within six months at periods following the last day of the Project Crediting Period in Section 3.3. The required schedule for Monitoring Reports is in Table 6.

Table 6: Post Project Crediting Period Monitoring Requirements

Years after last day of Project Crediting Period.
25
50
75
100

The Project Proponent must submit the Monitoring Report to a Verification Body for verification in accordance with the verification and Monitoring requirements of the Regulation. Reversals that occur after the Project Crediting Period are addressed in the same manner as during the Project Crediting Period.

APPENDIX A: PARAMETER CONSTANTS USED IN EQUATIONS

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
GWP	The global warming potential specified by the B.C. government for each GHG.	N/A	tCO_2e	Various	Where applicable, GWP is derived from the National Inventory Report (NIR) or the Intergovernmental Panel on Climate Change (IPCC) latest assessment, whichever is more recent. Emissions factors can be found in the NIR unless stated otherwise.	
MW_{CO_2}	Molecular weight of CO_2.	44	g/mole	Equation 4 Equation 8 Equation 27		
MW_C	Molecular weight of carbon.	12	g/mole	Equation 4 Equation 8 Equation 27		
$HWPfact_{NA}$	The factor, derived from Table 2, for the proportion of CO_2 remaining after the number of years between harvest and the Project Report Period, for products used in North America (*NA)*. Measured as a proportion.	N/A	Measured as a percentage.	Equation 7	Derived from Table 2: Fraction of typical BC product mix remaining in-use.	
$HWPfact_O$	The factor, derived from Table 2, for the proportion of CO_2 remaining after the number of years between harvest and the Project Report Period, for products used offshore *O*. Measured as a proportion.	N/A	Measured as a percentage.	Equation 7	Derived from Table 2: Fraction of typical BC product mix remaining in-use.	
$f_{C,\ wood}$	Fraction of the dry mass of wood, excluding bark that is carbon.	50%	Mass fraction	Equation 8 Equation 27	Petterson, R.C. (1984). The Chemical Composition of Wood. In R. Rowell (Ed.)	

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
					The Chemistry of Solid Wood, (pp. 57-126). Advances in Chemistry. DOI:10.1021/ba-1984-0207.ch002	
$vol_{s,d}$	Volume of delivered roundwood in m^3 of species *s* for each wood product destination *d*, extracted from the Project Site in each Project Report Period.	N/A	m^3	Equation 9	Based on sales invoices.	
wdf_s	Wood density factor for species *s*, from Table 3. Measured in t/m^3 .	N/A	t/m^3	Equation 9	Values after Gonzalez, J.S. (1990). *Wood density of Canadian tree species.* (Information Report (Northern Forestry Centre (Canada)); NOR-X-315).mThe trees known in BC as "balsam" are true firs. Spruce includes Engelmann Spruce, White Spruce, and Hybrid Spruce. Determined in Table 3: BC-specific wood density factors (wdfs) for oven-dry stemwood to convert from inside-bark harvested volume (m3) to mass.	
EF_f	Emission factor for GHG and fertilizer type *f*.	Dolomite (CO_2): 0.13	kg C/ kg	Equation 10	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1. Or, if applicable, in order of preference: 1. B.C. Reporting Regulation 2. Latest version of the B.C. GHG Inventory Report 3. Latest version of Canada's National GHG Inventory Report 4. Other recognized, justified reference Sources, with a preference for B.C.-specific data over national or international level data.	
		Limestone (CO_2): 0.12	kg C/ kg			
		Urea (CO_2): 0.2	kg C/ kg			
		Ammonia (CO_2): 671	M^3/tNH_3			
		Ammonia (natural gas	kg CO_2/m^3			

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
		(CO_2)): 2.162				
		Ammonia (urea - (CO_2)): 720	g CO_2 / kg			
AL_f	Quantity of fertilizer of type *f* applied during each Project Report Period.	N/A	kg of nitrogen-based fertilizer produced	Equation 10	Based on sales invoices.	
$Frac_{GASF}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for synthetic fertilizers.	0.1	Mass fraction	Equation 12 Equation 16		
$Frac_{GASM}$	Fraction of Nitrogen that volatilizes as NH_3 and NO_x for organic fertilizers.	0.2	Mass fraction	Equation 12 Equation 16		
$EF_{f,direct}$	Emission Factor for N additions from fertilizers.	0.010	Tonne N_2O-N / tonne N input	Equation 12	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.1	
MW_{N2O}	Molecular weight of N_2O.	44	g/mole	Equation 12 Equation 15		
MW_N	Molecular weight of N.	14	g/mole	Equation 12 Equation 15		
M_{SFi}	Mass of synthetic fertilizer of type *f* applied in during each Project Report Period, measured in tonnes.	N/A	Tonnes of nitrogen-based synthetic fertilizer	Equation 13	Estimated.	
$NC_{SF,f}$	Nitrogen content (mass fraction) of synthetic fertilizer type *f* applied.	N/A	Mass fraction	Equation 13	Manufacturer specifications.	
M_{OFv}	Mass of organic fertilizer of type *v* applied in each Project Report Period, measured in tonnes.	N/A	Tonnes of nitrogen-based	Equation 14	Based on sales invoices.	

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
			organic fertilizer			
NC_{OFv}	Nitrogen content of organic fertilizer type v applied.	N/A	Mass fraction	Equation 14	Manufacturer specifications.	
EF_{ATD}	Emission Factor for N_2O Emissions from atmospheric deposition of N on soils and water surfaces, tonne N_2O-N / tonne N input.	0.01	Tonne N_2O-N / tonne N input	Equation 16	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3	
$Frac_{Leach-(H)}$	Fraction of N lost by leaching and runoff.	0.30 or 0	Mass fraction	Equation 17	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3	
$EF_{(L)}$	Emission factor for N_2O-N Emissions from N leaching and runoff, tonne N_2O / tonne N input	0.0075	Tonne N_2O-N / tonne N input	Equation 17	2006 IPCC Guidelines, Vol. 4, Ch. 11. Table 11.3	
EF_b	The Emission factor for each GHGand Biomass type *b* (e.g. tonnes CH_4 per tonne of brush burned) (50% moisture content).	CO_2: 0.95 CH_4: 0.0005 N_2O: 0.00002	kg/kg	Equation 18	IPCC LULUCF Good Practice Guide (Table 3A.1.16). Other peer-reviewed Sources will be accepted. Some Biomass combustion Emission factors are / may be available in the B.C. Reporting Regulation, or B.C. or National Inventory Reports (in that order of preference, though note that at the time of protocol development such factors were not included in the B.C. inventory), and may be used so long as the Emission factor selected is appropriate for the type of Biomass and conditions under which it is being combusted. Otherwise, the Project Proponent will need to justify the use of an adjusted or alternative Emission factor based on recognized Sources wherever possible.	
AL_b	The quantity of Biomass of type *b* combusted during	N/A	Tonnes of nitrogen-based	Equation 18	Fuel consumption records or records by fuel type. Measured or Estimated - The Project Proponent must propose and	

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
	each Project Report Period.		synthetic fertilizer		justify an approach for determining the total mass of Biomass combusted during controlled burning events during a reporting period. Wherever possible, measured amounts of Biomass should be used (e.g. mass or volume of Biomass combusted), though it is recognized that in many cases (e.g. land clearing) such a measurement may not be possible and estimates based on site observations will be necessary. The guidance given in Approach B in the VCS Module VMD0031, Estimation of Emissions from Burning should be used as a basis for developing a method.	
e	Supply price elasticity	Interior: 0.31 Coastal: 0.66	The proportionate change in quantity supplied over change in price.	Equation 29	Determined with Table 7: Default values for estimating Project-specific leakage. Determined with Table 9: Additional Requirements for using coefficients in the Leakage equation. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs	
E	Demand price elasticity	Interior: -0.12 Coastal: -0.55	The proportionate change in quantity demanded over change in price.	Equation 29	Determined with Table 7: Default values for estimating Project-specific leakage. Determined with Table 9: Additional Requirements for using coefficients in the Leakage equation. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs.	
C_N	Carbon sequestration Reversal per unit of	1	tCO_2e/m^3	Equation 29	Determined with Table 7: Default values for estimating Project-specific leakage.	

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
	harvest from the non-reserved forest.				Determined with Table 9: Additional Requirements for using coefficients in the Leakage equation. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs.	
C_R	Carbon sequestration per unit of (forgone) harvest gained by preserving the reserved forest.	1	tCO_2e/m^3	Equation 29	Determined with Table 7: Default values for estimating Project-specific leakage. Determined with Table 9: Additional Requirements for using coefficients in the Leakage equation. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs.	
γ	The "substitution" parameter. A parameter introduced into the referenced Leakage equation to take into account specialty woods (i.e. the degree to which a particular HWP can be substituted for another).	Northern: 1.0000 Southern: 0.9622 Coast: 0.8719	m^3	Equation 29 Equation 31	Determined with Table 8. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs. Also see Appendix C: Project-Specific Harvest-shifting Leakage Determination, Appendix D: The Provincial Default Values for Addressing Leakage from Forest Carbon Projects, and Appendix E: Example Substitutability Equations.	
Φ	The "preservation" parameter. This is the ratio of timber supply being set aside for the Project (quantity Q_R) to the timber supply outside the offset area (quantity Q_N). The ratio can be represented as and can be thought of	0.01	m^3/m^3	Equation 29 Equation 30	Determined with Table 8. See Table 11: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs.	

Parameter	Description	Value	Units	Equations Used	Source and notes (if applicable)	
	as the market share of the timber in the Project.					
β	Percentage of units contributed to the Contingency Account at each Project Report Period.	N/A	tCO_2e	Equation 28 Equation 32	Determined in Appendix H: Risk of Reversal Determination.	
Y	Number of years starting at the Project inception and continuing 100 years past the termination of the Crediting Period.	125	Years	Equation 33		
DRI	Mean disturbance return interval based on natural disturbance type.	N/A	Years	Equation 33	Government of British Columbia (1995). Biodiversity Guidebook (Province of British Columbia, Victoria, Canada, 110 pp.), found in Table 20.	

APPENDIX B: REFERENCES

Environment and Climate Change Canada. *National Inventory Report (NIR): Greenhouse Gas Sources and Sinks in Canada.* Retrieved from http://www.publications.gc.ca/site/eng/9.506002/publication.html.

Intergovernmental Panel on Climate Change (IPCC) (2006). *Guidelines for National Greenhouse Gas Inventories Volume 4: Agriculture, Forestry and Other Land Use.* Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html.

Intergovernmental Panel on Climate Change (IPCC) (2003). *Good Practice Guidance for Land Use, Land Use Change, and Forestry.* Retrieved from https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html.

International Standards Organization (ISO) International Standard 14064-2: 2019 Greenhouse Gases - Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements.

GHG Protocol (2006). *The GHG Protocol for Project Accounting.* Retrieved from https://ghgprotocol.org/standards/project-protocol.

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The Earth Partners. (2012). *Estimation of emissions from biomass burning version 1.0, sectoral scope 14*. (Verified Carbon Standard Methodology VMD0031). Retrieved from https://verra.org/methodology/vmd0031-estimation-of-emissions-from-burning-v1-0/.

APPENDIX C: PROJECT-SPECIFIC EXTERNAL HARVEST-SHIFTING LEAKAGE DETERMINATION

If a Project Proponent chooses not to select the provincial default values to calculate external Harvest-shifting Leakage, they may use Equation 29 to determine that rate.

The Project Proponent must assert in the Project Plan that Project-specific Leakage rates are representative of the Project and include justification for this assertion.

Equation 29: % Leakage from external Harvest-Shifting

$$\%Leakage_{External\ Harvest\ Shifting} = \frac{(100 * e * \gamma * C_N)}{([e - E * (1 + \gamma * \Phi)] * C_R)}$$

Where,

Parameter	Description	Default Value
%Leakage$_{ExternalHarvest\text{-}shifting}$ *(shortened as %Leakage in Appendix B)*	Total increase in Project Emissions due to external Harvest-shifting Leakage during each Project Report Period, expressed as a percentage of the net Removals that is expected to shift to lands outside the ownership or control of the Project Proponent over the Project Report Period.	
e	Supply price elasticity.	See Below
E	Demand price elasticity.	
C_N	Carbon sequestration Reversal per unit of harvest from the non-reserved forest.	
C_R	Carbon sequestration per unit of (forgone) harvest gained by preserving the reserved forest.	
Φ	The “preservation” parameter. This is the ratio of timber supply being set aside for the Project (quantity Q_R) to the timber supply outside the offset area (quantity Q_N). The ratio can be represented as and can be thought of as the market share of the timber in the Project.	
γ	The “substitution” parameter. A parameter introduced into the referenced Leakage equation to take into account specialty woods (i.e. the degree to which a particular HWP can be substituted for another).	

The Project Proponent may use the variables that are used in the *Provincial Default Approach for Estimating Leakage* provided in Appendix C for supply price elasticity (E), demand price elasticity (E), and the carbon sequestration values (C_N and C_R) as identified in Table 7.

Table 7: Default values for estimating Project-specific leakage

Variable description	Default Equation Values (Interior)	Default Equation Values (Coast)
Supply price elasticity.	e = 0.31	e = 0.66
Demand price elasticity	E = -0.12	E = -0.55
Carbon sequestration Reversal per unit of harvest from the non-reserved forest.	C_N = 1	C_N = 1
Carbon sequestration per unit of (forgone) harvest gained by preserving the reserved forest.	C_R = 1	C_R = 1

In order to tailor Leakage estimates to reflect a Project Specific Leakage case, it is recommended that the Project Proponent focus on developing their own Project Specific parameters to reflect the preservation parameter (Φ) and the substitutability parameter (**γ**).

Table 8: Variables recommended to be developed by the Project Proponent for estimating Project Specific Leakage estimates

Variable description	Equation Variable
Substitution Parameter – A parameter introduced into the referenced Leakage equation to take into account specialty woods. Project Proponents who can demonstrate that specialty woods are prevalent in their Project Site develop the substitutability parameter using Equation 30. Otherwise, the default values provided in Table 7 must be used, reflecting the location of the Project.	**γ**
Preservation parameter – The ratio of timber supply being set aside for the Project to the timber supply outside the Project Site (the market share of the timber in the Project).	Φ

Methodology for deriving a substitutability parameter (γ)

There are two key factors to consider when determining the substitutability parameter of a Project 1) tree species breakdown of the Project Site, and 2) cross-species product substitutability of each given species, e.g., how many cedar products can be replaced with pine products?

A Project Proponent must use a representative and validated sample of tree species harvest makeup for their Project Site.

Equation 30: Weighted Substitution Parameter

$$\gamma = \sum_{s=1}^{n} T_s * S_s$$

Where,

Parameter	Description	Default Value
γ	The "substitution" parameter. A parameter introduced into the referenced Leakage equation to take into account specialty woods (i.e. the degree to which a particular HWP can be substituted for another).	
s	A specific tree type	N/A
n	Number of tree types within the Project	N/A
T_s	Tree type *i*'s share of Project's total marketable tree volume	N/A
S_s	Substitutability of tree type *i*	N/A

If a substitution parameter is determined for this representative sample, on average it is going to be accurate (representative) of a Project in this area, taking into account "specialty woods" that are more difficult to substitute, such as cedar or cypress. The contribution to total harvest of these specialty woods is combined with species-specific substitutability to create a weighted average for the substitutability parameter. The weighted average is then applied to the Leakage equation, reducing Leakage from a Project by the weighted average (represented as a percentage) of its original level.

Methodology for deriving a preservation parameter (Φ)

The preservation parameter (Φ) represents the ratio of timber set aside for the offset Project (quantity Q_R) to the timber supply outside the Project Site (quantity Q_N). The ratio can be represented as and can be thought of as the market share of the timber in the Project.

Option 1: The Project Proponent may determine their own preservation parameter according to Equation 31.

Equation 31: Preservation parameter

$$\Phi = \frac{Q_R}{Q_N}$$

Where,

Parameter	Description	Default Value
Φ	The "preservation" parameter. This is the ratio of timber supply being set aside for the Project (quantity QR) to the timber supply outside the offset area (quantity QN). The ratio can be represented as Q_R/Q_N and can be thought of as the market share of the timber in the Project.	
Q_R	Quantity of harvestable timber (m^3) to be claimed during Project Report Period.	N/A
Q_N	Quantity of harvestable timber supply (m^3) remaining in the market.	N/A

The remaining supply of timber (Q_N) will be the five year average annual total timber harvest in North America for the most recent period.

Option 2: The provincial default Leakage values use a 1% (.01) preservation parameter.

Additional requirements Project Specific Leakage

Where a Project-specific Leakage approach is taken for deriving any of the parameters in Equation 29, the additional requirements detailed in Table 9 must also be satisfied.

Table 9: Additional Requirements for using coefficients in the Leakage equation

Supply (E) and Demand (E) Elasticities	• North American market data must be used when estimating elasticities for the purpose of determining Leakage from Projects in B.C.
	  ○ The price elasticities of total demand and supply of BC logs should be used that incorporate the dynamics of domestic and significant international markets relative to BC (e.g. US, China, and Japan). Otherwise, relevant price elasticities of total demand and supply for BC lumber may be used with appropriate justification.
	  ○ The uniqueness of B.C. forests, and therefore a B.C. based Project, will be captured by the substitution parameter.
	• Elasticity estimates used by a Project Proponent for both supply and demand must be derived from the same data sets and information/ study in order to ensure consistency in derivation and validate their application for estimating Project Leakage.
	• Both market supply and market demand elasticities used in the Protocol Leakage methodology must be long-run elasticity estimates.

Carbon sequestration values (**C_N** and **C_R**)	• Project Proponents choosing to develop their own Leakage value must use a value of 1 for C_N and C_R in the Leakage formula.
Preservation Parameter (Φ)	• Project Proponents that estimate this parameter must demonstrate the harvest potential (or forgone harvest since the last Project Report Period) that their respective Project has in terms of total North American timber sales over the previous year.
Substitutability Parameter (**γ**)	• The Project Proponent must follow the substitution guidelines when calculating their own substitution parameter (see Appendix E: Example Substitutability Equations). • Project Proponents must demonstrate the tree species contribution/makeup within their Project Site. • The Project Proponent must demonstrate the substitutability of tree species in terms of potential wood products. • The Project Proponent must apply long-run, own- and cross-price elasticities of demand for substitutable wood products in North American market to derive the substitutability parameters.

APPENDIX D: THE PROVINCIAL DEFAULT VALUES FOR ADDRESSING LEAKAGE FROM FOREST CARBON PROJECTS

Growing conditions, the destinations of wood, and tree type vary considerably between the interior and coastal regions of B.C.. In addition, areas in the southern interior of B.C. can vary considerably from the northern interior. These differences impact the parameters of the Leakage equation (Appendix C, Equation 29) and as such we examine default values for the northern interior, southern interior and coastal regions separately.

Assumptions made for the default values of both the coast and northern and southern interior reflect what are simple and representative offset Projects in each respective region. Assumptions such as tree type, location, and product type can all impact the estimated Leakage. As a result these calculations could be modified on a Project to Project basis by the Project Proponent through using the Leakage equation guidelines in the Protocol and by referring to the default Scenarios.

A Project timeline of 100 years to be consistent with monitoring provisions in the Regulation. To reflect this long-run market elasticities are used instead of short-run elasticities. The market share of the default offset Project is assumed to be 1% (Φ = .01) of the total North America market. CR and CN are assumed to be the same and are given values of 1 as a conservative assumption to lower the chance of underestimating Leakage.

Table 10: Leakage Estimate and Parameters Using the Price Elasticities of Total Supply and Demand of BC Logs

	Total Supply Price Elasticity (E)	**Total Demand Price Elasticity** (E)	**Preservation Parameter (φ)**	**Carbon Sequestration Reversal from Non-reserved Forest (CN)**	**Carbon Sequestration gained from the reserved Forest (CR)**	**Substitution (γ)**	**%Leakage**
Northern Interior	0.31	-0.12	0.01	1	1	1.0000	**71.89**
Southern Interior	0.31	-0.12	0.01	1	1	0.9622	**69.18**
Coast	0.66	-0.55	0.01	1	1	0.8719	**47.37**

3. Northern Interior B.C. Default Values:

In this guideline, the northern interior region of B.C. is generally referred to as the northern part of the province that contains pine and spruce trees as the dominant leading species. Although the majority of BC lumber products are exported to the US, domestic and other significant international export markets need to be considered to reflect a more complete and accurate picture of market conditions when determining default Leakage parameters. Specifically, we examine the Canadian export market to the US, China, and Japan. Therefore, supply and demand elasticities of BC logs in both domestic and the three predominant international markets mentioned are used. Default Leakage values are estimated via using export supply price elasticity (E) of 0.31, and a demand price elasticity (E) of -0.12 (Latta and Adams, 2000). From this, the provincial default estimate of Leakage for the Northern Interior is 71.9%, as seen in Table 11 below.

Table 11: Northern Interior Leakage Estimation

e = 0.31
E = -0.12
C_R = 1
C_N = 1
Φ = .01
γ = 1
L = 71.9%

For the northern interior default values, it is assumed that the wood supplied from this geographic area can be substituted with any number of other wood alternatives (harvested in B.C. or elsewhere) to generate the same product lines. Tree species that have a high number of alternative species, in terms of the product lines they are geared for are referred to as highly substitutable. This is generally the case for species such as pine and spruce which are the leading commercial timber species in the northern interior.

There may be instances where the Project Proponent have other species of commercially harvestable timber within their Project Site. If the Project Proponent can demonstrate that these commercial tree species have low or moderate substitutability, it is recommended that the Project Proponent utilize the methodology applied in the coastal and southern interior default values to refine/ tailor the northern interior default values to reflect their specific Project dynamics.

4. Coastal B.C. Default Values:

This default value represents an offset Project in coastal B.C. instead of in the northern interior. Good growing conditions for trees on the coast, allowing trees to become larger more quickly than other areas of the province, make coastal areas desirable for offset Projects.

Supply and demand elasticities for coastal logs are comparatively higher than the interior (Sun et al. (2015), Latta & Adams, 2000). For regions that grow certain woods that have few substitutes for their product lines, such as cedar on the coast, Leakage is likely lower. This is simply due to the fact that the constrained supply is not replaced, or less easily replaced by the supply of another wood species. There is a supply constraint and less likelihood of Harvest-Shifting relieving that constraint. Therefore coastal Projects (or Projects in areas containing woods with low substitutability) warrant lower Leakages.

Applying the substitutability parameter to reflect low substitutability woods on the coast indicates the Leakage estimate is reduced to 47.4% for the coastal default value as indicated in Table 12 below. It is important to note that the default value for the coast represents the average mix of tree species in the total harvest area of the coastal region. Leakage estimates for Projects on the coast can vary according to species composition and the proportion of low substitutability species to high substitutable species in the Project Site. An example calculation result of 54.3% Leakage is also shown in Table 13 below if we assumed perfect substitutability of species on the coast:

Table 12: Coastal Leakage Estimation

Perfect Substitutes	**Moderate Substitutes**
$e = 0.66$	
$E = -0.55$	
$C_R = 1$	
$C_N = 1$	
$\Phi = .01$	
$\gamma = 1$	$\gamma = .8719$
%Leakage = 54.3%	**%Leakage = 47.4%**
$e = .342$	
$E = -.181$	
$C_R = 1$	
$C_N = 1$	
$\Phi = .01$	
$\gamma = 1$	$\gamma = .8479$
%Leakage = 65%	**%Leakage = 55.3%**

For the coastal default value, the average tree species mix for the entire coastal harvest region was used. To derive a substitutability parameter (γ) for a specific Project, a Project Proponent needs to ascertain the representative tree species mix for their specific Project Site (in place of the average tree species mix for the coastal harvest area). For the coastal default value, red cedar and cypress are identified as low substitutability woods, white pine is identified as moderately substitutable. All other commercially harvested trees in the coastal region are assumed to be perfectly substitutable (100% substitutability).

A total of 21.28% of wood (cedar and cypress) has 40% substitutability. White Pine, making up 0.12%, is 70% substitutable. The remaining 78.59% of the wood is 100% substitutable, this means that all products from a tree in this category can be replaced by the same or similar products of other trees.

This weight is then applied to the Leakage equation, reducing Leakage from the ‘perfectly substitutable’ default value (the northern interior default value) to approximately 87% of its original level and is now representative of the total average coastal market. See Table 14 and associated calculation below.

Table 13: Low and moderately substitutability wood as a contribution of total coastal harvest

	Cedar	Cypress	White Pine	Other	Total
Harvest Contribution (T)	18.71%	2.57%	0.12%	78.59%	100.00%
Substitution (S)	40%	40%	70%	100%	87.19%

Coastal Substitution Calculation:

$$\gamma_{Coast} = T_{cedar} * S_{cedar} + T_{cypress} * S_{cypress} + T_{white\ pine} * S_{white\ pine} + T_{other} * S_{other}$$

$$\gamma_{Coast} = .1871 * .4 + .0257 * .4 + .0012 * .7 + .7859 * 1 = .8719$$

5. Southern Interior B.C. Default Value:

The southern interior default value represents the general geographic extent of cedar trees (a low substitutability wood) in the interior of B.C.. The southern interior of B.C. has a diversity of tree species and growing sites. Project Sites can be highly variable and it may be appropriate to derive a substitution parameter specific to individual Projects.

The methodology for estimating Leakage for the southern interior default value follows that of the coastal default value. In this default value, a substitutability parameter is derived to reflect the average tree species mix for the total southern interior harvest region.

Table 14: Low and moderately substitutable wood as contribution of total southern interior harvest

	Cedar	Larch, Yellow & White Pine	Other	Total
Harvest Contribution	4.63%	3.34%	92.03%	100%
Substitution	40%	70%	100%	96.22%

Southern Interior Substitution Calculation:

$$\gamma_{South} = T_{cedar} * S_{cedar} + T_{larch} * S_{larch} + T_{other} * S_{other}$$

$$\gamma_{South} = .0463 * .4 + .0334 * .7 + .9203 * 1 = .9622$$

Although the southern interior uses the same supply and demand elasticities as the northern interior and there is a higher substitutability of species than on the coast, it is not perfect substitutability. Therefore, the default Leakage estimate for the south interior is slightly lower at 69.2% when compared to the northern interior. See Table 16 below:

Table 15: Southern Interior Leakage Estimation

e = 0.31
E = -0.12
C_R = 1
C_N = 1
Φ = .01
γ = 0.9622
L = 69.2%

As with the coastal case, to derive a substitutability parameter (γ) for a specific Project in the southern interior, a Project Proponent needs to ascertain the representative tree species mix for their specific Project Site and reflect that in the calculation with the respective substitutability of those tree species.

APPENDIX E: EXAMPLE SUBSTITUTABILITY EQUATIONS

The substitution parameter measures the rate of response of quantity demanded of product *N* due to the <u>quantity</u> change of product *R.* Hence, in order to get the substitution parameter from cross price elasticity, the following calculation is applied:

Substitution parameter = cross price elasticity for product *R** inverse of own price elasticity of product *R*

$$S = \frac{dq_N/q_N}{dq_R/q_R} = \frac{dq_N/q_N}{dp_R/p_R} * \frac{dp_R/p_R}{dq_R/q_R}$$

The substitutabilities of low/ moderately substitutable wood (imperfect substitutes) in this paper are determined base on the references listed below.

Table 16: Own and cross-price elasticities of demand for softwood lumber products (US: January 1989 to July 2001)

Own- and cross-price elasticities of demand for softwood lumber products, US: Jan. 1989 to July 2001.*						
Percentage effect on the quantity demanded of	For a 1% change in the price of					
	SPF	SYP-U	SYP-R	DF	WSP	Other
SPF	-0.6196**	0.2365**	0.0015	0.0223	0.2985**	0.0608
	(0.022)	(0.015)	(0.012)	(0.014)	(0.013)	(0.035)
SYP-U	0.3985**	-0.7189*	-0.0420	0.0070	0.3811**	-0.0257
	(0.025)	(0.035)	(0.024)	(0.018)	(0.020)	(0.056)
SYP-R	0.0093	-0.1569	-1.7949**	2.0646**	0.2163	-0.3384
	(0.076)	(0.089)	(0.234)	(0.178)	(0.211)	(0.381)
DF	0.0661	0.0123	0.9707**	-1.6226**	0.3994**	0.1741
	(0.040)	(0.031)	(0.084)	(0.147)	(0.142)	(0.227)
WSP	0.3460**	0.2622**	0.0398	0.1565**	-1.1059**	0.3014**
	(0.015)	(0.013)	(0.039)	(0.056)	(0.072)	(0.101)
Other	0.0837	-0.0210	-0.0740	0.0810	0.3577**	-0.4275*
	(0.048)	(0.045)	(0.083)	(0.105)	(0.120)	(0.192)
** and * indicate significance at the 1% and 5% levels, respectively. Figures in parentheses are standard errors: *SE* (η_j) = *SE* $(\beta_i)/m_i$ (Binswanger 1974, Pindyck 1979)						

Source: Nagubadi et al. (2004)

Table 17: Long-term elasticities of demand for US softwood lumber imports from Canada by species

	Elasticities							
	P_d	Y	Spruce	Pine	Fir	Hemlock	Red Cedar	Others
Spruce	2.33*	0.63*	-2.76*	0.16	0.20	0.13	0.11	0.20
	(0.76)	(0.07)	(0.57)	(0.10)	(0.13)	(0.08)	(0.07)	(0.13)
Pine	2.33*	0.63*	2.73*	-6.33*	0.53*	0.33*	0.29*	0.53*
	(0.76)	(0.07)	(0.74)	(0.95)	(0.14)	(0.09)	(0.08)	(0.14)
Fir	2.33*	0.63*	-1.07*	-1.17*	-0.31	-0.13*	-0.11*	-0.21*
	(0.76)	(0.07)	(0.48)	(0.08)	(0.32)	(0.06)	(0.05)	(0.09)
Hemlock	2.33*	0.63*	1.14	0.18	0.22	-3.83*	0.12*	0.22
	(0.76)	(0.07)	(0.62)	(0.10)	(0.12)	(0.71)	(0.06)	(0.12)
Red Cedar	2.33*	0.63*	-0.57	-0.09	-0.11	-0.07	-1.03*	-0.11
	(0.76)	(0.07)	(0.45)	(0.07)	(0.09)	(0.05)	(0.15)	(0.09)
Others	2.33*	0.63*	-0.62	-0.10	-0.12	-0.08	-0.07	-1.01*
	(0.76)	(0.07)	(0.45)	(0.07)	(0.09)	(0.06)	(0.05)	(0.20)

NOTE: Numbers in parentheses are approximate standard errors that ignore possible correlation between the import shares and elasticities in the equations provided. Elasticity values indicate the price of imports of various species.
*Significantly different from zero at the 5% significance level using a two-tailed test.

Source: Hseu and Buongiorno (1993)

Only substitutable woods with the price elasticities that are higher than 5% significance level are considered in calculating the substitution parameters. For example, to calculate the substitution parameter for red cedar:

$$S_{red\ cedar} = \frac{E_{pine}}{E_{red\ cedar}} + \frac{E_{hemlock}}{E_{red\ cedar}} = \frac{.29}{-1.03} + \frac{.12}{-1.03} = -40\%$$

To calculate the substitution parameter for larch, the table from Nagubadi *et al.* (2004) is used:

$$S_{larch} = \frac{E_{wsp}}{E_{other}} = \frac{.3014}{-.4275} = -70\%$$

Note that the price elasticities of larch, ponderosa pine, redwood, white pine and other lumber were grouped together in the “Other” group in this reference.

APPENDIX F: B.C. TIMBER HARVESTING VOLUME BY SPECIES AND REGION

Table 18: Timber harvesting volume proportion five-year average (2015-2019)

North Interior	5 Year Avg. Harvest % by Species
Alder	0.00%
Aspen	4.45%
Balsam	13.30%
Birch	0.07%
Cedar	0.82%
Cottonwood	1.01%
Cypress	0.01%
Fir	0.81%
Hemlock	2.18%
Larch	0.00%
Lodge-Pine	42.46%
Spruce	34.90%
White Bark Pine	0.00%
White Pine	0.00%
Yellow Pine	0.00%

South Interior	5 Year Avg. Harvest % by Species
Alder	0.00%
Arbutus	0.00%
Aspen	0.30%
Balsam	9.09%
Birch	0.09%
Cedar	4.63%
Cottonwood	0.03%
Cypress	0.00%
Fir	23.48%
Hemlock	3.43%
Larch	2.87%
Lodge-Pine	33.77%
Maple	0.00%
Spruce	21.82%
White Bark Pine	0.01%
White Pine	0.32%
Willow	0.00%
Yellow Pine	0.14%

Coast	5 Year Avg. Harvest % by Species
Alder	0.72%
Arbutus	0.00%
Aspen	0.01%
Balsam	10.21%
Birch	0.02%
Cedar	18.71%
Cottonwood	0.29%
Cypress	2.57%
Fir	30.24%
Hemlock	34.56%
Lodge-Pine	0.31%
Maple	0.11%
Spruce	2.12%
White Bark Pine	0.00%
White Pine	0.12%
Willow	0.00%
Yellow Pine	0.00%
Yew	0.00%

Source: Harvest Billing System, FLNRORD

* all logs, special forest products, species and grades billed to crown, private and federal land excluding waste and reject. Christmas trees are excluded. For all scale invoiced as of date of reporting - December 16, 2019.

APPENDIX G: B.C. FOREST DISTRICTS BY REGION

Forest Districts used for identifying average tree species mix for the North, South and Coast Areas of BC

Table 19: Forest Districts by Region

Coast Area
Chilliwack
Campbell River
North Island – Central Coast
Queen Charlotte Islands
Sunshine Coast
South Island
Metro Vancouver - Squamish
North Area
Fort Nelson
Fort St James
Kalum
MacKenzie
Nadina
Peace
Prince George
Skeena Stikine
Vanderhoof
South Area
Cariboo-Chilcotin
Cascades
Thompson Rivers
Selkirk
100 Mile
Okanagan Shuswap
Quesnel
Rocky Mountain

APPENDIX H: RISK OF REVERSAL DETERMINATION

Determining the Risk of Reversal

Contributions to the Contingency Account will be determined by natural disturbance type, and is equal to the percentage likelihood of non-survival, as represented by Equation 32.

Equation 32: Percentage of units contributed to the Contingency Account

$$\beta = 1 - P^{Y} - RMM$$

Where,

Parameter	Description	Default Value
β	Percentage of units contributed to the Contingency Account at each Project Issuance	N/A
P^{Y}	Chance of surviving up to *t* years without a disturbance. Determined with Equation 33.	N/A
RMM	Risk Mitigation Measures. See below.	N/A

Equation 33: Chance of surviving up to *t* years without a disturbance

$$P^{Y} = \exp\left(\frac{-Y}{DRI}\right)$$

Where,

Parameter	Description	Default Value
P^{Y}	Chance of surviving up to *Y* years without a disturbance, DRI. This is the negative exponential version of equation 6.3 on page 81 of Johnson, EA 1992. Fire and Vegetation Dynamics (Cambridge University Press).	N/A
Y	Number of years starting at the Project inception and continuing 100 years past the termination of the Crediting Period.	125 years
DRI	Mean disturbance return interval based on natural disturbance type, found in Table 20. Mean disturbance intervals are from Government of British Columbia (1995). Biodiversity Guidebook (Province of British Columbia, Victoria, Canada, 110 pp.).	See Table 20

Table 20: Mean disturbance return interval

Natural disturbance type	Mean disturbance return interval (*DRI*)
1: Ecosystems with rare stand-initiating events	250 years for the CWH and ICH,
	350 years for the ESSF and MH
2 – Ecosystems with infrequent stand-initiating events	200 years
3 – Ecosystems with frequent stand-initiating events	100 years for wind-dominated CWH and SBPS and BWBS with deciduous species prominent.
	125 years for the SBS and BWBS with coniferous species prominent.
	150 years for ESSF, ICH and MS units
4 – Ecosystems with frequent stand-maintaining fires	150 to 250 for the IDF (stand replacing)
5 – Alpine Tundra and Subalpine Parkland ecosystems	Not clear in part because open, woodland type ecosystems, may not fit definition of forest.

Table 21 summarizes the chance of survival and corresponding Contingency Account contribution rates:

Table 21: Chance of survival and corresponding Contingency Account contribution rates

Natural disturbance type	Mean disturbance return interval (*DRI*)	Chance of surviving up to 25 years	Chance of surviving up to 125 years	Risk of Reversal
1: Ecosystems with rare stand-initiating events	250 years for the CWH and ICH,	0.90	0.61	0.39
	350 years for the ESSF and MH	0.93	0.70	0.30
2 – Ecosystems with infrequent stand-initiating events	200 years	0.88	0.53	0.46
3 – Ecosystems with frequent stand-initiating events	100 years for wind-dominated CWH and SBPS and BWBS with deciduous species prominent.	0.78	0.29	0.71
	125 years for the SBS and BWBS with coniferous species prominent.	0.82	0.37	0.63
	150 years for ESSF, ICH and MS units	0.85	0.43	0.56
4 – Ecosystems with frequent stand-maintaining fires	150 to 250 for the IDF (stand replacing)	0.85 to 0.90	0.43 – 0.61 (average is 0.52)	0.48
5 – Alpine Tundra and Subalpine Parkland ecosystems	Not clear in part because open, woodland type ecosystems, may not fit definition of forest.			

Determining Risk Mitigation Measures

Deductions to the Risk of Reversal may be applied based on mitigating factors specific to the Project. For each Risk Mitigation Measure, Proponents will be required to identify what natural disturbance that Risk Mitigation Measure is addressing, in addition to the likelihood and magnitude of risk mitigated through each measure. Assumptions used to inform the Risk Mitigation Measure selection must use peer-reviewed research, government publications (from the Government of Canada or Government of B.C.), or data from within 10 years.

Risk Mitigation Measures may include (but are not limited to):

- The Project takes place within a FireSmart area,
- An annual Fire Plan in place for the Project Site,
- Fire line construction within the Project Site,
- Initial fire suppression equipment on or adjacent to the Project Site,
- Regular low intensity burning used to control fuel load,
- Diversity of tree species within the Project Site,
- Relevant improved (i.e. drought resistant) tree genotypes used within the Project Site,
- Road accessibility,
- Use of remote sensing,
- Moisture regime of Project Site,
- Slope of stands within the Project Site are less than 10%,
- The Project Site is more than 5 kilometers from a railroad, and
- Decreased risk to the Project due to Project type.