Mexico Forest Protocol

Draft for Workgroup Review
Sections 4 through 6

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Abbreviations and Acronyms

CH_4	Methane
CO_2	Carbon dioxide
CONAFOR	Comisión Nacional Forestal
CRT	Climate Reserve Tonne
FMP	Forest Management Program
FPC	Forest Project Coordinator
GHG	Greenhouse gas
IFM	Improved Forest Management
IPCC	Intergovernmental Panel on Climate Change
MFP	Mexico Forest Protocol
N_2O	Nitrous oxide
PIA	Project Implementation Agreement
PR	Project Report
RAN	National Agrarian Registry
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks
Reserve	Climate Action Reserve
SEMARNAT	Secretaria de Medio Ambiente y Recursos Naturales
SSR	Source, sink, and reservoir
UNFCCC	United Nations Framework Convention on Climate Change
VR	Verified removal

4 GHG Assessment Boundary

The GHG Assessment Boundary encompasses all the GHG sources, sinks, and reservoirs that may be significantly affected by Forest Project activities, including forest carbon stocks, sources of biological CO_2 emissions, and GHG emissions from mobile combustion. For accounting purposes, the sources, sinks, and reservoirs included in the GHG Assessment Boundary are organized according to whether they are predominantly associated with a Forest Project's "Primary Effect" (i.e., the Forest Project's intended changes in carbon stocks, GHG emissions or removals) or its "Secondary Effects" (i.e., unintended changes in carbon stocks, GHG emissions or removals caused by the Forest Project).[1] Secondary Effects may include increases in mobile combustion CO_2 emissions associated with site preparation, as well as increased CO_2 emissions caused by the shifting of harvesting activities from the Project Area to other forestlands (often referred to as "leakage"). Projects are required to account for Secondary Effects from leakage following the methods described in Section 5.4.

The following table provides a comprehensive list of the GHG sources, sinks, and reservoirs (SSRs) that may be affected by a Forest Project and indicates which SSRs must be included in the GHG Assessment Boundary depending on the project specifics. If an SSR is designated as a reservoir/pool, this means that GHG removals are accounted for by quantifying changes in carbon stock levels. For SSRs designated as sources or sinks, GHG removals are accounted for by quantifying changes in GHG emission or removal rates, as described in the tables.

[1] The terms "Primary Effect" and "Secondary Effect" come from WRI/WBCSD, 2005. *The Greenhouse Gas Protocol for Project Accounting*, World Resources Institute, Washington, DC. Available at http://www.ghgprotocol.org.

Table 4.1. GHG Assessment Boundary

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs						
1	Standing live carbon (carbon in all portions of living trees)	Reservoir / Pool	CO_2	Included	**Baseline**: Based on initial field inventory measurements; methodology outlined in Section 5.2 **Project**: Measured by field measurements and updating forest carbon inventory through remeasurement and growth projections	Increases in standing live carbon stocks are the Primary Effect of carbon enhancement projects.
2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Included for estimating site preparation emissions	**Baseline**: N/A **Project**: Estimates based on change in carbon resulting from site preparation	For crediting purposes, shrubs and herbaceous understory carbon is excluded since changes in this reservoir are unlikely to have a significant effect on total quantified GHG removals. Furthermore, it is generally not practical to undertake measurements of shrubs and herbaceous understory that are accurate enough for crediting purposes. Clearing of shrubs and herbaceous understory for purposes of reforestation activities may have significant emissions.
3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline**: Measured based on initial field inventory measurements **Project**: Measured by updating forest carbon inventory	Carbon enhancement projects may significantly increase standing dead carbon stocks over time.
4	Lying dead wood carbon	Reservoir / Pool	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	Lying dead wood is difficult to obtain accurate measurements and it is most often conservative to not include them.

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	Litter and duff carbon is excluded since changes in this reservoir are unlikely to have a significant effect on total quantified GHG removals. Furthermore, it is generally not practical to undertake measurements of litter and duff that are accurate enough for crediting purposes.
6	Soil carbon	Reservoir / Pool/Source	CO_2	Excluded for crediting Required for certain management activities	**Baseline**: N/A **Project**: N/A	Soil carbon is anticipated to increase somewhat as a result of most carbon enhancement project activities that do not include intensive site preparation. Soil carbon cannot be included as a credited reservoir/pool as it is difficult to get accurate estimates. Deep ripping, as a site preparation practice, may not occur on more than1% of an Activity Area on an annual basis. See Section 3.11 for further details.
7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	While long-term harvested wood products may increase, along with onsite forest carbon, due to improved management, long-term wood products are not included as creditable data supporting long-term sequestration of harvested wood products is lacking. This may be modified in the future as data related to the fate of harvested wood products is developed. Additionally, improved forest management projects will lead to increased production over medium to long-term.
8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	No data has been obtained to suggest wood products remain in long-term storage in landfills in Mexico. This may be modified in the future as data related to the fate of harvested wood products is developed.
Secondary Effects Sources, Sinks, and Reservoirs						
9		Source	N_2O	Excluded	**Baseline:** N/A	

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
	Nutrient application				**Project:** N/A	The use of broadcast fertilization is not an eligible activity.
10	Mobile combustion emissions from site preparation activities	Source	CO_2	Included	**Baseline**: Assumed to be zero	Mobile combustion CO_2 emissions from site preparation may be important when machinery is used to prepare areas for planting.
					Project: Accounted for by intensity of site preparation activities	
			CH_4	Excluded	**Baseline**: N/A	Changes in CH_4 emissions from mobile combustion associated with site preparation activities are not considered significant.
					Project: N/A	
			N_2O	Excluded	**Baseline**: N/A	Changes in N_2O emissions from mobile combustion associated with site preparation activities are not considered significant.
					Project: N/A	
11	Mobile combustion emissions from ongoing project operation and maintenance	Source	CO_2	Excluded	**Baseline**: N/A	Mobile combustion CO_2 emissions from ongoing project operation and maintenance are unlikely to be significantly different from baseline levels and are therefore not included in the GHG Assessment Boundary.
					Project: N/A	
			CH_4	Excluded	**Baseline**: N/A	CH_4 emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
					Project: N/A	
			N_2O	Excluded	**Baseline**: N/A	N_2O emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
					Project: N/A	
12	Stationary combustion emissions from ongoing project operation and maintenance	Source	CO_2	Excluded	**Baseline**: N/A	Stationary combustion CO_2 emissions from ongoing project operation and maintenance could include GHG emissions associated with electricity consumption or heating/cooling at Forest Owner facilities or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from baseline levels and are therefore not included in the GHG Assessment Boundary.
					Project: N/A	

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
			CH_4	Excluded	**Baseline**: N/A **Project**: N/A	CH_4 emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.
			N_2O	Excluded	**Baseline**: N/A **Project**: N/A	N_2O emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.
13	Biological emissions from clearing of forestland outside the Activity Area for agriculture and/or grazing	Source	CO_2	Included	Baseline: N/A Project: Estimated using default land use conversion factors for non-project land	Projects on land currently, or projected to be used for, grazing or growing crops may cause displacement of these activities to other lands, leading to a reduction in carbon stocks on those lands (e.g., due to clearing of trees and shrubs). The shift may be either a market response or physical response to the project activity. Emissions associated with shifting land uses are estimated using default "leakage" factors outlined in Section 5.4 of the protocol.
14	Biological emissions or removals from changes in timber harvesting on forestland outside the Activity Area	Source / Sink	CO_2	Included/ Excluded	Baseline: N/A Project: Estimated using default land use conversion factors (Section 5.4)	If harvesting is reduced in the Activity Area, harvesting on other lands may increase to compensate for the lost production. This "leakage" effect is outlined in Section 5.4 of the protocol. Projects may also increase harvesting levels relative to the baseline, potentially causing other landowners to reduce harvesting in response to increased wood product supply. The reduction in harvesting may lead to increased carbon stocks on their lands.
15	Combustion emissions from production, transportation, and disposal of forest products	Source	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	The Primary Effect of Forest Projects in Mexico is to conserve and increase onsite forest carbon stocks, without substantially affecting the production, transportation, and disposal of wood products with regards to baseline levels. Therefore, these emissions are not included in the GHG Assessment Boundary of this protocol.

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
			CH_4	Excluded	**Baseline**: N/A **Project:** N/A	Combustion-related CH_4 emissions from changes in the production, transportation, and disposal of forest products are not considered significant.
			N_2O	Excluded	**Baseline**: N/A **Project**: N/A	Combustion-related N_2O emissions from changes in the production, transportation, and disposal of forest products are not considered significant.
16	Combustion emissions from production, transportation, and disposal of alternative materials to forest products	Source	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	The Primary Effect of Forest Projects in Mexico is to conserve and increase onsite forest carbon stocks, without substantially affecting the production, transportation, and disposal of wood products with regards to baseline levels. Therefore, these emissions are not quantified in the assessment boundary of this protocol.
			CH_4	Excluded	**Baseline**: N/A **Project**: N/A	Combustion-related CH_4 emissions from changes in the production, transportation, and disposal of alternative materials are not considered significant.
			N_2O	Excluded	Baseline: N/A **Project**: N/A	Combustion-related N_2O emissions from changes in the production, transportation, and disposal of alternative materials are not considered significant.
17	Biological emissions from decomposition of forest products	Source	CO_2	Excluded	**Baseline**: N/A **Project**: N/A	While long-term harvested wood products may increase, along with onsite forest carbon, due to improved management, long-term wood products are not included as creditable data supporting long-term sequestration of harvested wood products is lacking.
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A	In-use wood products will produce little to no CH_4 emissions. CH_4 emissions can result from anaerobic decomposition of forest products in landfills. Additionally, dimensional wood products are assumed to be in landfills in minimal quantities. Thus, changes in forest-product production are assumed to have no significant effect on future CH_4 emissions from anaerobic decomposition of forest products in

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method	Justification/Explanation
						landfills. These emissions are therefore excluded from the GHG Assessment Boundary.
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A	Decomposition of forest products is not expected to be a significant source of N_2O emissions.

5 Quantifying Net GHG Removals and CRTs

This section provides requirements and guidance for quantifying a Forest Project's net GHG removals from within the Activity Areas. For projects with multiple Activity Areas, the quantification of net GHG removals is conducted separately for each Activity Area. The Reserve will issue CRTs to a Forest Project upon confirmation by an ISO-accredited and Reserve-approved verification body that the Forest Project GHG removals have been quantified and secured following the applicable requirements of this section (see Section 8 for verification requirements).

The quantification method proceeds in six steps:

1. **Quantifying the Activity Area live and dead standing carbon.** Each Reporting Period, the Forest Owner must determine the Activity Area carbon stocks in live and dead standing trees. There are two approaches to quantifying the Activity Area live and dead standing carbon discussed in Section 5.1 and Appendices B and C.
2. **Determining the Activity Area baseline onsite carbon stocks.** The baseline is determined for each Activity Area as the initial forest carbon stocks. Projects are eligible to receive credits to the extent they increase forest carbon inventories above baseline levels within the Activity Areas. The guidance for determining an Activity Area baseline is discussed in Section 5.2. and Appendices B and C. The baseline is established for renewable 30-year crediting periods.
3. **Calculating the Activity Area Primary Effect.** Each Reporting Period, the Forest Owner must quantify the actual change in GHG removals associated with the Activity Area's intended ("Primary") effect. For any given year, the Primary Effect is calculated by:
    a. Taking the difference between actual onsite carbon stocks for the current year and actual onsite carbon stocks for the prior year.[2]
    b. Subtracting from (a) the difference between baseline onsite carbon stocks for the current year and baseline onsite carbon stocks for the prior year.
4. **Quantifying the Activity Area Secondary Effects.** Each Reporting Period, the Forest Owner must quantify the actual change in GHG emissions or removals associated with the Activity Area's unintended ("Secondary") effects, as defined in Section 5.4. Requirements and guidance for quantifying Secondary Effects are provided below for each type of activity. Should the project activity result in Secondary Effects, only increased emissions as the result of the project activity will be included to ensure conservative accounting.
5. **Calculating total net GHG removals.** For each Reporting Period, total net GHG removals are calculated by summing an Activity Area's Primary and Secondary Effects. If the result is positive, then the Activity Area has generated GHG removals in the current year. If the result is negative, this may indicate that a reversal has occurred (see Section 6.1).

6. **Calculating total CRTs to be issued.** For years in which net removals occur, the amount of CRTs issued is adjusted to reflect both how long the current inventory of additional carbon has been sequestered and how long it is secured into the future through the Project Implementation Agreement. This adjustment indicates the tonne-

[2] For the purposes of calculating the project's Primary Effect, actual and baseline carbon stocks prior to the Start Date of the project are assumed to be zero.

year value of the additional carbon (see the Section 5.5.1 on tonne-year accounting) and represents the current climate benefit attributable to the project in lieu of a 100-year commitment to the maintenance of such additional carbon. The total CRTs issued for each Activity Area are then summed for the Forest Project for each Reporting Period.

The required formula for quantifying annual net GHG removals is presented in Equation 5.1. Net GHG removals must be quantified and reported in units of carbon dioxide-equivalent (CO_2e) metric tonnes. The results from Equation 5.1 are used as input for Equation 5.5, as outlined in Section 5.5, to determine the amount of CRTs to be issued for the Reporting Period.

Equation 5.1. Annual Net GHG Removals

$$QR_y = [(\Delta AC_{onsite} - \Delta BC_{onsite}) + \Delta AC_{shrub,init} + SE_y] + N_{y-1}$$

Where,

			Units
QR_y	=	Quantified GHG removals for Reporting Period *y*	
$\Delta AC_{shrub,init}$	=	Change in actual onsite carbon in shrubs resulting from site preparation for reforestation, quantified only at the initiation of project activities in Reforestation Activity Areas where site preparation involves the removal of shrub cover.	tCO_2e
SE_y	=	Secondary Effect GHG emissions caused by the Activity Area activity in Reporting Period *y*	tCO_2e
N_{y-1}	=	Any negative carryover from the prior Reporting Period (occurs when total quantified GHG removals are negative prior to the issuance of any CRTs for the Activity Area)	

And,

$$\Delta AC_{onsite} = (AC_{onsite,\,y})(1 - CD_y) - (AC_{onsite,\,y-1})(1 - CD_{y-1})$$

Where,

$AC_{onsite,\,y}$	=	Actual onsite carbon in standing live and dead trees in Activity Areas as inventoried for Reporting Period *y*	tCO_2e
$AC_{onsite,\,y-1}$	=	Actual onsite carbon in standing live and dead trees in Activity Areas as inventoried for Reporting Period *y-1* (if y is the first Reporting Period of the Activity Area, then the value for $AC_{onsite,\,y-1}$ will be zero)	tCO_2e
CD_y	=	Appropriate confidence deduction for Reporting Period *y*, as determined in Appendix B	
CD_{y-1}	=	Appropriate confidence deduction for Reporting Period *y-1*, as determined in Appendix B	

And,

$$\Delta BC_{onsite} = BC_{onsite,\,y} - BC_{onsite,\,y-1}$$

Where,

$BC_{onsite,\,y}$	=	Baseline onsite carbon in standing live and dead trees in Activity Areas as estimated for Reporting Period *y*	tCO_2e
$BC_{onsite,\,y-1}$	=	Baseline onsite carbon in standing live and dead trees in Activity Areas as estimated for Reporting Period *y-1* (if *y* is the	tCO_2e

	first Reporting Period of the Activity Area, then the value for $BC_{onsite, y-1}$ will be zero)

5.1 Quantifying the Activity Area Live and Dead Standing Carbon

There are two different approaches to quantifying the Activity Area live and dead standing carbon based on activity. For projects with multiple Activity Areas, the quantification of live and dead standing carbon is conducted separately for each Activity Area.

5.1.1 Improved Forest Management, Restoration, Large Urban Forestry

For IFM, Restoration, and Large Urban Forestry Activity Areas an intensive inventory is required. An intensive inventory requires that field sample plots be installed, measurements acquired, and data input into the Reserve's Microsoft (MS) Access database, CALCBOSK, for analytical purposes. This does not require a re-measurement of the inventory each year, but does require that inventory estimates be updated using the guidance in Appendix B. The estimate of actual carbon stocks in live and dead standing trees must be adjusted by an appropriate confidence deduction, as described in Appendix B.

5.1.2 Reforestation

Reforestation Activity Areas must likewise use the intensive inventory methodology described in Appendix B. However, Reforestation Activity Areas may defer the inventory of carbon stocks that are not affected by site preparation until the second full verification, the scheduling of which is at the discretion of the Project Developer. By the second full verification, the Forest Owner must provide an estimated inventory of all required carbon stocks by using the intensive inventory methodology. Activity Areas for which an initial inventory is deferred are not eligible to receive CRTs until after the second full verification where the inventory is verified.

5.1.3 Small Urban Forestry, Agroforestry, and Silvopastoral

Small Urban Forestry, Agroforestry, and Silvopastoral Activity Areas may use the canopy cover inventory methodology described in Appendix C. Nevertheless, Project Developers always maintain the option to use the intensive inventory methodology for all Activity Areas as described in Section 5.1.1 of the protocol and Appendix B.

The canopy cover inventory methodology includes deriving a measurement of the canopy area within the Activity Area, which are applied to ratio estimators to produce an estimate of CO_2e for the Activity Area. Ratio estimators represent a relationship between CO_2e in standing trees and canopy cover, providing the ability to estimate the CO_2e in standing trees across the Activity Area as a function of the Activity Area's overall canopy cover. For Activity Areas using the canopy cover inventory methodology, there is no confidence deduction. Appendix C provides for further guidance for using the canopy cover inventory methodology.

5.2 Determining the Activity Area Baseline

A Forest Project can be issued credits to the extent forest carbon stocks within the Activity Area(s) have increased above and beyond baseline forest carbon stocks. A baseline for purposes of crediting is established separately for each Activity Area.

For all Activity Areas that comply with the additionality criteria, the initial baseline for the Activity Area is defined as the sum of carbon (CO_2e) in the required carbon pools at the Start Date.

The protocol allows for new Activity Areas to be added to the Project Area following the project Start Date. For additional Activity Areas added at a later time, the Forest Owner must calculate the baseline for the new Activity Area. The Appendices B and C provides further instructions on how to calculate the baseline for each Activity Area depending on the activity and quantification approach used.

5.2.1 Consideration of Legal Constraints

Legal constraints include all laws, regulations, and legally binding commitments applicable to the Project Area at the project initiation that could affect standing live or dead carbon stocks. Legal constraints are considered for determining eligibility and additionality rather than baseline quantification. Projects that comply with additionality criteria, including those related to legal requirements, may thus receive credits for carbon enhancements above the Activity Area baseline (i.e. initial carbon stocks).

5.2.2 Consideration of Financial Constraints

Financial constraints are considered for determining eligibility and additionality rather than baseline quantification. Projects that comply with additionality criteria may thus receive credits for carbon enhancements above the Activity Area baseline (i.e. initial carbon stocks).

5.3 Calculating Emissions from Site Preparation Activities

As identified in Section 4, emissions must be estimated for the release of carbon resulting from site preparation involving the removal of shrub cover for Reforestation Activity Area. Estimates of the loss of shrub carbon stocks resulting from the removal of shrub cover during site preparation activities in Reforestation Activity Areas must be calculated using the following steps:

1. Estimate pre-site preparation shrub carbon stocks for the Activity Area using the canopy cover inventory methodology, as described in Appendix C. Quantifying Carbon Stocks in Activity Areas: Canopy Cover Quantification Methodology, based on a satellite image from a date close to but before the date that site preparation activities were initiated.
2. Estimate post-site preparation shrub carbon stocks using the canopy cover inventory methodology based on a satellite image from a date after the site preparation activities were completed.
3. Calculate the difference between pre- and post-site preparation shrub stocking by subtracting the results from Step 1 from Step 2.

The difference is the value used for the variable $\Delta AC_{shrub,init}$ in Equation 5.1. Contact Reserve staff if no image is available for either Step 1 or Step 2.

5.4 Calculating the Activity Area Primary Effect

For all Activity Areas, each Reporting Period, the Forest Owner must quantify the actual change in GHG removals associated with the Activity Area's intended ("Primary") effect. The Carbon Monitoring Worksheet facilitates the calculation of the Activity Area's Primary Effect each Reporting Period.

5.5 Quantifying the Activity Area Secondary Effects

The approach to Project Area monitoring, established by the 5th Environmental Safeguard (Section 3.11), provides assurances that forest enhancement activities do not result in increased forest carbon emissions throughout the Project Area. Nevertheless, significant

Secondary Effects can arise from mobile combustion emissions associated with machinery used in site preparation for Reforestation activities. It is also possible that forest enhancement activities result in emissions on external sites. The approach to the calculation of Secondary Effects on external sites is split into an analysis conducted for Reforestation, Restoration, Agroforestry, and Silvopastoral activities and an analysis for Improved Forest Management activities. Large and Small Urban Forestry activities have an inherent low risk of secondary effects and thus are exempt from the secondary effects analysis.

5.5.1 Secondary Effects from Mobile Combustion for Reforestation Activities

To quantify combustion emissions associated with site preparation, project proponents must use the appropriate standard emission factor from Table 5.1. corresponding to the level of brush cover associated with the site preparation area, multiplied by the number of hectares treated (Equation 5.2). Project proponents must only quantify these emissions for the areas where mechanical equipment, i.e., brush raking or mastication, is used for the removal of competing vegetation site preparation. Mobile combustion emissions must be added to any Secondary Effect emissions from external sites (SE in Equation 5.3) in the first reporting period for a Reforestation Activity Area.

Table 5.1. Mobile Combustion Emissions for Reforestation Activities

Site Prep - Reforestation Activities		
Emissions Factors Associated with Mobile Combustion Average Tonnes CO_2 per Hectare		
Light	**Medium**	**Heavy**
25% Brush Cover	50% Dense Brush Cover	> 50% Brush Cover, stump removal
0.036	**0.082**	**0.174**

Equation 5.2. Combustion Emissions Associated with Site Preparation

$$SE_y = (-1) \times (EF_{mc} \times PA)$$

Where, Units

			Units
SE_y	=	Secondary Effect emissions due to mobile combustion from site preparation for the Reporting Period *y* (first Reporting Period only for Reforestation Activity Area)	t CO_2e
EF_{mc}	=	Mobile combustion emission factor from Table 5.1.	t CO_2e
PA	=	Size of the site preparation area	hectares

5.5.2 Secondary Effects from External Sites for Reforestation, Restoration, Agroforestry, and Silvopastoral Activities

Reforestation, Restoration, Agroforestry, and Silvopastoral activities may result in a shift of grazing or agricultural activities outside the Project Area. Project Developers must analyze the effect of Reforestation, Agroforestry, and Silvopastoral activities for each Activity Area at the activity inception. This is a one-time assessment for this activity and the results are used throughout the Project Life. Using the decision matrix in Figure 5.1, the Project Developer must determine the percentage associated with the risk of Secondary Effects. The percent identified is incorporated into Equation 5.3. Secondary Effect Emissions for Reforestation, Restoration, Agroforestry and Silvopastoral Activities below as the Leakage Risk Percentage (*LR*) to calculate the Secondary Effects value (*SE_y*) used in Equation 5.1 and the Reserve's Carbon

Monitoring Worksheet (CMW). The percentage value is applied as a constant to each Reporting Period to adjust calculated CO_2e removals in the Reporting Period.
In the first reporting period for Reforestation Activity Areas, Secondary Effect emissions from external sites must be added to any mobile combustion emissions, as calculated in Equation 5.2.

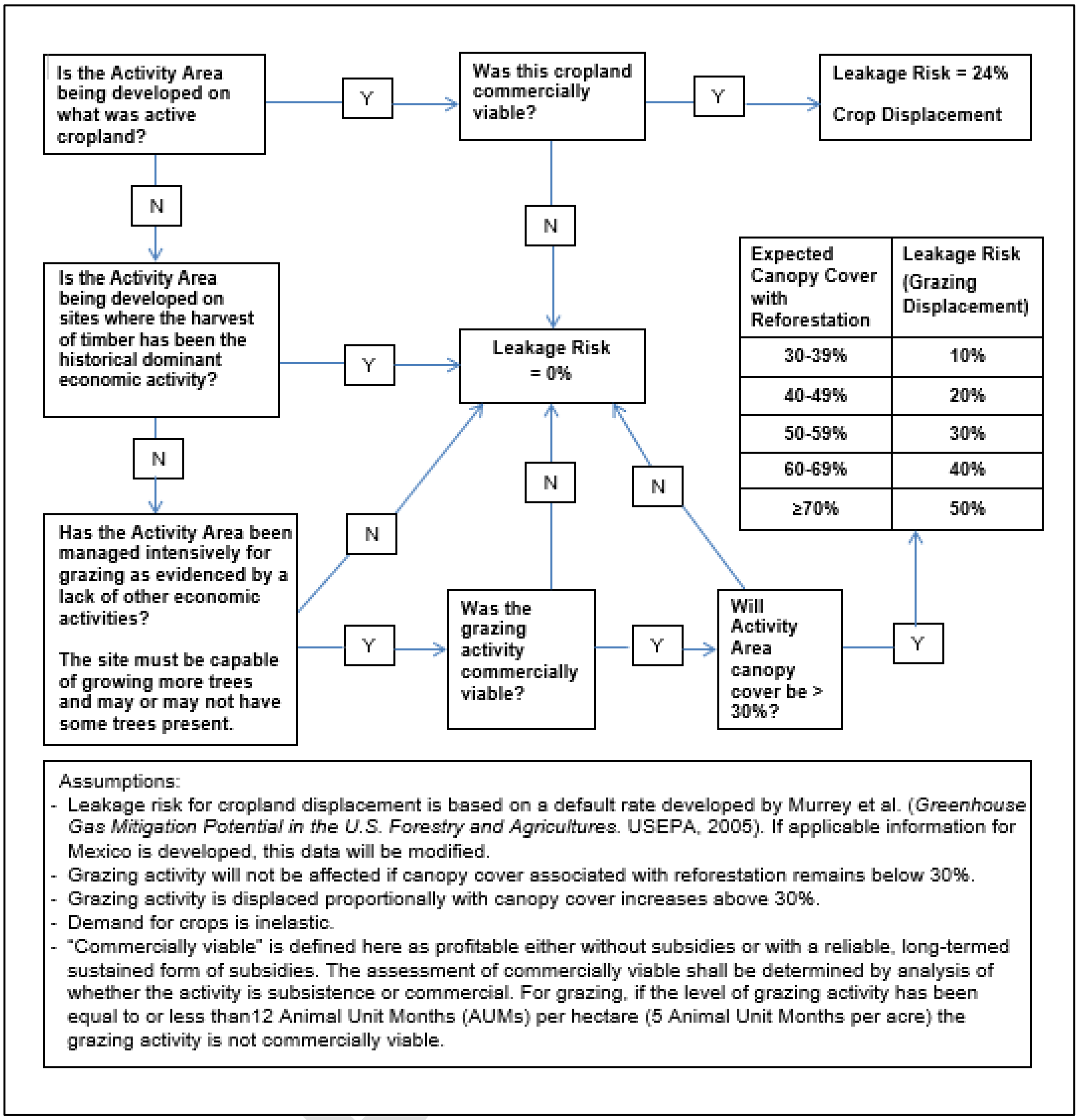


Figure 5.1 Risk Assessment for Reforestation, Restoration, Agroforestry and Silvopastoral Activity Areas

Equation 5.3. Secondary Effect Emissions for Reforestation, Restoration, Agroforestry and Silvopastoral Activities

$$SE_y = (\Delta AC_{onsite,y} - \Delta BC_{onsite,y}) * LR \text{ or } 0\text{, whichever is lower}$$

Where,		Units
SE_y	= Secondary Effects due to shifting of cropland or grazing activities	tCO_2e

$AC_{onsite,\ y}$	=	Actual onsite carbon in standing live and dead trees in Activity Areas as inventoried for Reporting Period *y*	tCO_2e
$BC_{onsite,\ y}$	=	Baseline onsite carbon in standing live and dead trees in Activity Areas as estimated for Reporting Period *y*	tCO_2e
LR	=	Leakage Risk Percentage (Figure 5.1)	%

5.5.3 Secondary Effects for Improved Forest Management Activities

For Improved Forest Management activities, Secondary Effects can occur if a project reduces harvesting in the Activity Area(s), resulting in an increase in harvesting (along with associated emissions) outside the Activity Area(s).

The assumption under this protocol is that Secondary Effects may occur because of project activities. However, the amount of Secondary Effects is dependent on how much harvesting occurs on the Activity Area relative to the baseline scenario. This protocol considers the impacts of shifting harvest activities over the project life. Improved Forest Management activities, where harvesting is anticipated to be an ongoing activity over the project life, are anticipated to increase harvest levels over time compared to baseline management due to improved stocking and growth levels and harvesting closer to an optimal age to enhance forest productivity. However, Secondary Effects must be reported annually due to the risk that Secondary Effects may be occurring in any given year.

Equation 5.3 must be used to estimate the Secondary Effects risk for improved forest management activities. Recognizing that Secondary Effects from projects may be influenced by long term harvesting trends, the evaluation in Equation 5.3 considers how actual cumulative harvest amounts vary from baseline cumulative harvest amounts since activity inception.

When baseline cumulative harvested carbon exceeds actual cumulative harvested carbon - *but actual onsite harvested carbon exceeds the baseline amount in a given reporting period* - net GHG reductions are increased (Equation 5.4.B). This allows for prior deductions for Secondary Effects to be recouped, because the risk has been lowered. However, once actual cumulative harvest amounts exceed baseline cumulative harvest amounts, Secondary Effects risk is zero, and will remain zero for as long as actual cumulative harvest amounts exceed baseline cumulative harvest amounts (Equation 5.4.A). Under no circumstance shall the net balance of Secondary Effects CRTs over the course of an Activity Area life be positive. However, maintaining actual cumulative harvest above baseline cumulative harvest will allow an Activity Area to accrue any uncredited positive carryover that can counteract the amount of future Secondary Effects deductions that would be applied if baseline cumulative harvested carbon were to exceed actual harvested carbon again (Equation 5.4.C). The Reserve provides a calculation workbook for quantifying Secondary Effects risk (in addition to the other calculations required by the protocol).

Values used for onsite carbon harvested in the Activity Area actual and baseline scenarios ($AC_{hv,n}$ and $BC_{hv,n}$) shall represent all harvested trees, not just merchantable species.

Equation 5.4. Secondary Effects Emissions for Improved Forest Management Activity Areas

Equation 5.4.A:

$$\boldsymbol{If} \sum_{n=1}^{y} (\boldsymbol{AC_{hv,n}} - \boldsymbol{BC_{hv,n}}) \geq 0, and \sum_{n=1}^{y-1} \boldsymbol{SE_n} \geq 0,$$

$$then\ \boldsymbol{SE_y} = \boldsymbol{0}^{\dagger}$$

Equation 5.4.B:

$$\boldsymbol{If}\left(\sum_{\boldsymbol{n=1}}^{\boldsymbol{y}}(\boldsymbol{AC_{hv,n}} - \boldsymbol{BC_{hv,n}}) < 0\ and\ \sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_n} < 0\right)\ or\ \left(\sum_{\boldsymbol{n=1}}^{\boldsymbol{y}}(\boldsymbol{AC_{hv,n}} - \boldsymbol{BC_{hv,n}}) \geq 0\ and\ \sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_n} < 0\right),$$

$$then\ \boldsymbol{SE_y} = \boldsymbol{MIN}\left(\left(\boldsymbol{AC_{hv,y}} - \boldsymbol{BC_{hv,y}}\right) \times \boldsymbol{20}\%, \left|\sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_n}\right|\right)$$

Equation 5.4.C:

$$\boldsymbol{If}\ \sum_{\boldsymbol{n=1}}^{\boldsymbol{y}}(\boldsymbol{AC_{hv,n}} - \boldsymbol{BC_{hv,n}}) < 0\ and\ \sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_n} \geq 0,$$

$$then\ \boldsymbol{SE_y} = \boldsymbol{MIN}\left(\textstyle\sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_n} + \left(\left(\boldsymbol{AC_{hv,y}} - \boldsymbol{BC_{hv,y}}\right) \times \boldsymbol{20}\%\right), \boldsymbol{0}\right)^{\dagger}$$

Where,

			Units
SE_y	=	Estimated annual Secondary Effects in the current reporting period *y*	tCO_2e
SE_n	=	Estimated annual Secondary Effects in reporting period *n*	tCO_2e
$AC_{hv,n}$	=	Actual amount of onsite carbon harvested in reporting period *n* (prior to delivery to a mill)	tCO_2e
$BC_{hv,n}$	=	Estimated average baseline amount of onsite carbon harvested in reporting period *n* (prior to delivery to a mill), as determined above	tCO_2e
$AC_{hv,y}$	=	Actual amount of onsite carbon harvested in current reporting period *y* (prior to delivery to a mill)	tCO_2e
$BC_{hv,y}$	=	Estimated average baseline amount of onsite carbon harvested in current reporting period *y* (prior to delivery to a mill), as determined in Section 5.5.3.1	tCO_2e

† Secondary Effects are not awarded CRTs but may accrue as positive carryover. Annual accruals are calculated in the same way that Secondary Effects are calculated when baseline cumulative harvested carbon exceeds actual harvested carbon. Cumulative Secondary Effects as of the current reporting period are calculated by the following: $\sum_{\boldsymbol{n=1}}^{\boldsymbol{y}}\boldsymbol{SE_{as,n}} = \sum_{\boldsymbol{n=1}}^{\boldsymbol{y-1}}\boldsymbol{SE_{as,n}} + ((\boldsymbol{AC_{hv,y}} - \boldsymbol{BC_{hv,y}}) \times \boldsymbol{20}\%)$. Positive carryover reduces or negates future Secondary Effects deductions.

5.5.3.1 Developing the Baseline of Harvested Wood Products

A baseline of harvested wood products is developed based on the six years' worth of harvest data prior to the Activity Area Start Date, or the longest set of harvest data available if records going back six years do not exist. Since harvest volume usually originates as volumetric reports, there are several steps to complete the conversion, using default conversion estimators. The process steps are provided below, followed by an example in Figure 5.2.

Step 1. Develop historical annual values of harvested wood products and develop an average.

The Project Developer must be careful to align any harvested wood products reports or estimates with the boundaries of the Activity Area. Harvest that occurred outside of the Activity Area shall not be included in the dataset. Historical data shall be based on annual reports (submitted to SEMARNAT, if applicable). The dataset shall be presented by conifers and hardwoods in the Project Report on an annual basis for the past six full calendar years prior to the Activity Area Start Date, or the longest time in which data were collected if records going back six full years are not available. An average must be developed for both species groups.

Step 2. Convert the log volume to whole tree volume.

Since a shift in GHG emissions would affect whole tree volume, not just the portion associated with wood products, the value must be adjusted to estimate the whole tree volume associated with the reported log volume. This is done by dividing the log volume by 0.6. This default value is assumed to be the same for hardwoods and softwoods.

Step 3. Convert the whole tree volume to biomass.

Multiply the conifers by 0.53 and hardwood by 0.75 to develop a value for conifers and hardwoods of tonnes per cubic meter and sum the conifer and hardwood values.

Step 4. Convert the biomass values to CO_2e.

Multiply the summed biomass values by 0.5 to convert the biomass values to tonnes of carbon and multiply by 3.67 to calculate tonnes of CO_2e.

Step 5. Enter the tonnes CO_2e associated with baseline harvested wood products into the Secondary Effects worksheet provided by the Reserve.

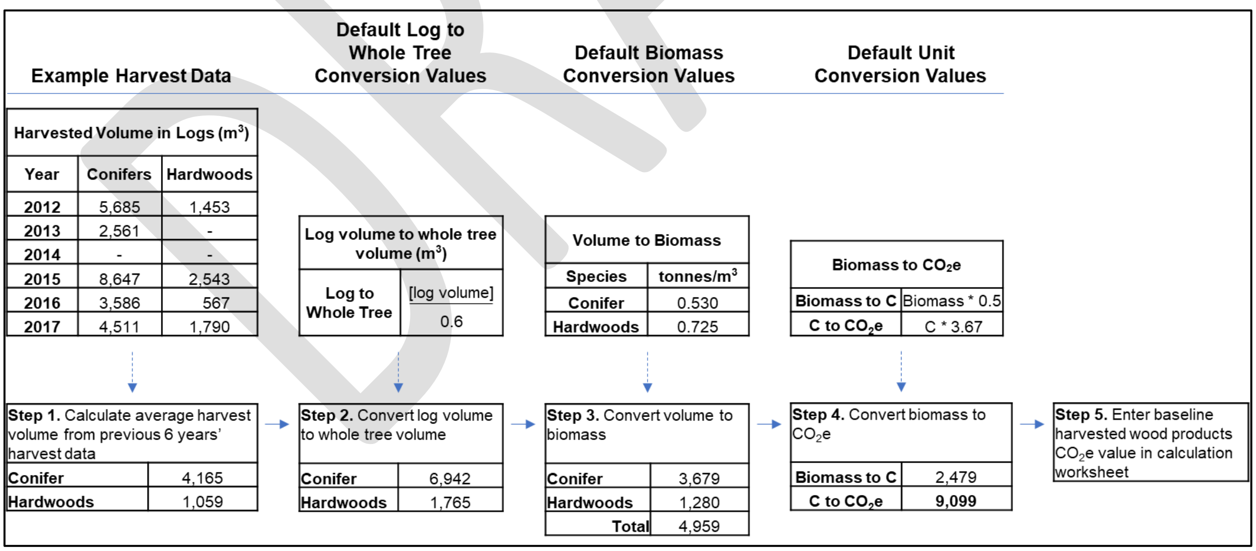


Figure 5.2. An example of the computational steps to develop an Activity Area baseline of harvested wood products.

5.5.3.2 Developing the Annual Report of Harvested Wood Products

An annual report of harvested wood products must be calculated to compare to the baseline harvested wood products estimate developed using the guidance in 5.5.3.1. The inclusion of a harvested wood products value in the Reserve's Secondary Effects calculation tool only occurs when there is at least 365 days' (one year's) worth of harvest data to compare to the baseline estimate. Therefore, the project may be exempt from calculating Secondary Effects for the first Reporting Period of the Activity Area, unless the first Reporting Period happens to be one full year. Reported wood products are included from the last full calendar year's data for the Activity Area and based on the same annual reports submitted to SEMARNAT. As an example, a monitoring period that begins on 1-April-2017 and concludes on 31-March-2018 will use the harvest report from 2017 as the basis of the annual report of harvested wood products for the Secondary Effects calculations. In this example, the 2017 harvest data would only be included in the annual report of harvested wood products and would not be included in the historical average for the baseline harvested wood products. Do not prorate the harvested wood products values from two different calendar year reports.

The annual calculation is conducted using the same approach to conversions that was used for the baseline calculation, excepting that the annual reporting is based on an actual single year's value rather than an averaged set of data.

5.5.3.3 Calculating Secondary Effects from Improved Forest Management Activities

Annual Secondary Effects (SE_y) are calculated as described in Equation 5., using baseline and actual annual harvest amounts as determined above. The results of this calculation are then applied to Equation 5.1.

Table 5.2. Examples: How Secondary Effects Can Be Recouped and Positive Carryover Can Be Applied Over Time

a. Qualitative example				
Reporting Period	**Greater of Actual or Baseline**		**Protocol Equation Reference**	**Secondary Effect**
	Annual	**Cumulative**		
1	Baseline	Baseline	Equation 5.4.B	Negative Secondary Effect resulting in deduction applied to GHG reductions
2	Actual	Baseline	Equation 5.4.B	Positive Secondary Effect resulting in recouping of previously deducted GHG reductions up until the cumulative Secondary Effect is zero
3	Actual	Actual	Equation 5.4.A	No Secondary Effect, excepting any previous negative Secondary Effect deductions that have not been recouped and including any positive Secondary Effects that are carried over to the following year
4	Baseline	Actual	Equation 5.4.C	No Secondary Effect, though adjusting any positive Secondary Effect carryover and carrying forward any remaining balance to the following year
5	Baseline	Baseline	Equation 5.4.B	Negative Secondary Effect resulting in deduction applied to GHG reductions, with deduction lowered by any positive secondary effects carryover from when actual cumulative harvest carbon exceeded baseline cumulative harvested carbon
b. Quantitative example				

Reporting Period	1	2	3	4	5
Annual actual carbon in harvested trees	500	**1,400**	**1,400**	800	800
Annual baseline carbon in harvested trees	**1,000**	1,000	1,000	**1,000**	**1,000**
Cumulative actual carbon in harvested trees	500	1,900	**3,300**	**4,100**	4,900
Cumulative baseline carbon in harvested trees	**1,000**	**2,000**	3,000	4,000	**5,000**
Cumulative difference between actual and baseline C in harvested trees	(500)	(100)	300	100	(100)
Annual difference between actual and baseline C in harvested trees	(500)	400	400	(200)	(200)
Gross annual Secondary Effects	(100)	80	80	(40)	(40)
Adjusted gross annual Secondary Effects, not allowing positive cumulative Secondary Effects but not including positive Secondary Effects carryover	(100)	80	20	0	(40)
Carryover of positive Secondary Effects from prior year	NA	0	0	60	20
Net annual Secondary Effects	**(100)**	**80**	**20**	**-**	**(20)**

5.6 Calculating total CRTs to be Issued

Under this protocol, credits are issued based on the proportion of carbon that is stored or secured through contract over a 100-year permanence period. Tonne-year accounting principles are used to quantify the time-value of storing carbon as a relative proportion of the 100-year permanence. The longer that sequestered and verified carbon is maintained (or contractually secured), the more credits are issued. The full credit for all carbon sequestered will be issued 100 years after the date it was initially sequestered, or to the full temporal extent the sequestered carbon is secured through contractual agreement. If a contractual agreement guarantees the maintenance of carbon stocks for a period longer than one year (e.g., 30 years), then credits will be issued based on the time-value of storing carbon for the guaranteed period, relative to 100 years (e.g., the time-value for storing carbon for 30 out of 100 years).

5.6.1 Tonne-Year Accounting and Credit Issuance

In order to meet the permanence requirements of this protocol, one credit (CRT) is issued for each tonne of CO_2e removed from the atmosphere for a period of 100 years. Tonnes of CO_2e sequestered and stored for shorter periods will receive a fractional amount of credits according to the length of time the sequestered CO_2e is stored and/or contractually secured. Specifically, for each additional tonne of CO_2e that is stored and verified, credits will be issued proportional to the value of the atmospheric impact of sequestering and maintaining each tonne for the amount of time in which it is secured. This is achieved by multiplying the number of tonnes of sequestered CO_2e in a given Reporting Period by the simplified radiative forcing coefficient of 1% per year. If a Forest Owner commits to maintaining carbon for a period longer than one year, credits will be issued proportional to the length of the commitment – e.g. 0.3 credits per tonne that is secured for 30 years.

The commitment to secure CO_2e must be established through the PIA (Section 3.16, with the Reserve. Equation 5.5, below, shows the formula for determining the number of credits that will be issued for a carbon sequestered in any given year.

Equation 5.5. Formula for Credit Issuance under Tonne-Year Accounting

$$CRT_y = \sum_{n=1}^{y} (QR_n \times (YR_n + CL_y) \times 0.01 - PC_n)$$

Where,

			Units
CRT_y	=	Sum of credits to be issued in Reporting Period *y*	CRTs
QR_n	=	Quantified GHG removals for Reporting Period *n*, for each Reporting Period in which additional carbon was sequestered	tCO_2e
YR_n	=	Length of time since the initiation of Reporting Period *n* in which the additional carbon was sequestered, for each Reporting Period in which additional carbon was sequestered	Years
CL_y	=	Length of contractual agreement into future from current Reporting Period *y* that secures all sequestered carbon	Years
PC_n	=	Previous credits issued for Reporting Period *n*, for each Reporting Period in which credits were issued	CRTs

The benefit of the approach is that projects develop an ongoing economic incentive to protect against reversals over time, based on an expected stream of future credits as long as carbon is maintained.

Quantified GHG removals that have been verified through full or desk verifications, but are not yet secured are recognized by the Reserve as Verified Removals (VRs) and are not issued as CRTs until they have been secured through contract or time (see Section 7.4.1). If a contractual commitment is extended or renewed, further CRTs may be released based on the length of the extension. The proportion of further CRTs issued is thus based on the length of time the VRs will be secured and the simplified radiative forcing coefficient of 1% per year.

For example, if 100 tonnes of CO_2e is sequestered in the first Reporting Period, (determined by the Forest Owner to be one year from the Project Start Date), and the Forest Owner submits the Project Report at the end of the first Reporting Period, and secures the 100 tonnes of CO_2e by contract against reversals for 30 years, then 31 CRTs will be issued upon verification. This is based on using the simplified radiative forcing coefficient of 1% per year multiplied by the combination of the 1 year for which the tonnes have already been maintained and the 30 years for which the tonnes are secured through contract.

$$CRT_p = (100 \times (1 + 30) \times 1\% - 0)$$

Alternatively, if the first Reporting Period were 12 months, the first Project Report was not submitted until 12 months later at the end of the second Reporting Period, and the project was thus not verified until after the second Reporting Period, then 32 credits would be issued following verification.

$$\mathrm{CRT_p} = (100 \times (2 + 30) \times 1\% - 0)$$

In this second example, after the initial verification, the project would have 68 VRs that have not yet been issued as CRTs out of the initial 100 tonnes of CO_2e that were sequestered and verified. If, in the next year, the contract is extended by another year (so that the contract still has a term of 30 years total), using the simplified 1% radiative forcing coefficient, another 1 VR would be converted into a CRT in addition to the prior credits because the project has demonstrated another year toward the 100-year permanence requirement. Contracts may be extended in this way until the end of the contractual commitment reaches a date that is 100 years after the carbon was first sequestered. At that point, a total of 100 credits will have been issued for the 100 tonnes CO_2e sequestered in the first Reporting Period. An example is provided in Table 5.5, again using the simplified 1% radiative forcing coefficient.

Table 5.5. Example of CRT Issuance

Assumptions			1. Contract length = 30 years and is renewed annually. 2. Reporting Period 1 ends one year from the Start Date. 3. 3-Years of reporting are shown below.						
The amount of CRTs issued in any annual Reporting Period is determined by the amount of additional CO2e sequestered in the reporting year multiplied by the length of the contract term that secures the CRTs plus 1/100th multiplied times the CRTs issued in the Reporting Period to account for the project having met 1% of its 100-year permanency requirement.									
Reporting Period 1			Reporting Period 2			Reporting Period 3			
Quantified GHG Removals (*QR_1*)		100	Quantified GHG Removals (*QR_2*)		300	Quantified GHG Removals (*QR_3*)		100	
Reporting Period	Previous Credits Issued (*PC_n*)	Credits Issued (*CRT_1*)	Reporting Period	Previous Credits Issued (*PC_n*)	Credits Issued (*CRT_2*)	Reporting Period	Previous Credits Issued (*PC_n*)	Credits Issued (*CRT_3*)	Total CRTs Issued Each Reporting Period
1	0	**31**	1	0	0	1	0	0	**31**
2	31	**1**	2	0	**93**	2	0	0	**94**
3	32	**1**	3	93	**3**	3	0	**31**	**35**
Total CRTs issued through Reporting Period 3									**160**

Forest Owners may also choose not to contractually secure carbon sequestered by a project. In this case, credits will be issued over time based on the quantity of carbon that remains stored (as determined through monitoring and verification) in any given year relative to the 100-year permanence period. For example, if 100 tonnes of CO_2e is sequestered and verified in year one, one credit would be issued in year one, based on the simplified radiative forcing coefficient of 1% per year. If the full 100 tonnes remains stored and is verified in year two, an additional one credit would be issued in year two, again based on the simplified 1% for the radiative forcing coefficient. The verifying and crediting would continue as such until the full 100 credits are issued by the end of the 100-year permanence period.

6 Ensuring the Permanence of Credited GHG Removals

The Reserve requires that all credited GHG removals be effectively "permanent." For Forest Projects, this requirement is met by ensuring that the carbon associated with credited GHG removals remains stored for at least 100 years. However, as discussed in Section 3.17, under the MFP, projects may commit to maintaining carbon sequestered due to project activities for any length of time. Under the MFP, credits are issued based on the proportion of carbon that is stored or secured through contract over a 100-year permanence period. Tonne-year accounting principles, as described in Section 5.5 are used to quantify the time-value of storing carbon as a relative proportion of the 100-year permanence.

6.1 Definition of a Reversal

A GHG removal can be "reversed" if the carbon stored because of the removal is subsequently released to the atmosphere. Under tonne-year accounting, reversals need to be compensated for if they affect CRTs that are contractually secured against reversal. A reversal occurs if the quantified GHG removals for a given Reporting Period (QR_y in Equation 5.1) are negative, and a contractual obligation to retain carbon sequestered by the project has not yet expired.

Under this protocol, credits are considered reversed in the opposite order to which the credit was quantified and verified. For example, suppose a project was credited 100 tonnes of carbon in year 1 and another 50 tonnes in year 2. In year 3, a reversal occurs that releases 75 credits to the atmosphere. In this situation, the 50 credits issued in year 2 are considered reversed, along with 25 of the credits issued in year 1.

Reversals are considered avoidable if they are the direct result of human activities through acts of gross negligence. Reversals are considered unavoidable if they are the result of natural events, such as wildfire, insect-related mortality or wind.

6.2 Compensation Formula for Reversals

If a reversal affects secured CRTs, credits must be retired to fulfill the terms of the contract that secures the CRTs. Equation 6.6.1. shows the formula to use to determine how many CRTs to retire to compensate for a reversal affecting a specific vintage of sequestered carbon.

Equation 6.6.1. Formula to Determine the Number of CRTs to Retire to Compensate for a Reversal from a Specific Vintage

$$CRT_{ret} = RT_y \times s \times 0.01$$

Where,

			Units
CRT_{ret}	=	Number of credits to be retired	
RT_y	=	Quantity of tonnes in Reporting Period *y* that has been reversed	tCO_2e
s	=	Number of years remaining in the term of any contract securing the CRTs in Reporting Period *y-1* against reversals, including Reporting Period *y*	

The quantity CRT_{ret} must be determined for each vintage of carbon affected by a reversal. As indicated above, carbon is considered reversed in the opposite order to which its sequestration was quantified and verified. Furthermore, for quantification purposes, a reversal is assumed to have occurred at the start of the Reporting Period during which it occurred, regardless when during the Reporting Period it actually occurred.

6.2.1 Compensation of Unavoidable Reversals

An Unavoidable Reversal is any reversal that is not due to the Forest Owner's negligence, gross negligence or willful intent, including natural events like wildfires or disease. Requirements following an Unavoidable Reversal are as follows:

1. If the Forest Owner determines there has been an Unavoidable Reversal, the Annual Monitoring Report must clearly indicate that an Unavoidable Reversal has occurred.
2. The Forest Owner must explain the nature of the Unavoidable Reversal as part of the annual monitoring report and provide an estimate of onsite carbon stocks no later than 2 years following the occurrence (in units of CO_2-equivalent metric tons). Exceptions to this timing may be made if the Reserve agrees that an extension is warranted.
3. No transactions will be allowed until the reversal is verified.

If the Reserve agrees that the reversal is unavoidable in origin, the Reserve will retire a quantity of CRTs from its Buffer Pool (see below) for each vintage affected by the reversal, according to Equation 6.6.1. . The tracking of carbon stocks and any reversals will be transparent within the Registry and clearly indicate that the compensation has occurred.

6.2.2 Compensation of Avoidable Reversals

An Avoidable Reversal is any reversal that is due to the Forest Owner's negligence, gross negligence or willful intent, including harvesting, development, or harm to the Activity Area. Reversals are detected during annual monitoring and verification events. Subsequent to the identification of a reversal, the following requirements apply:

1. A written description and explanation of the reversal must accompany the Annual Monitoring Report.

2. Within one year of receiving an Avoidable Reversal notice, the Forest Owner must provide the Reserve with an estimate of current onsite carbon stocks. The Forest Owner will then need to complete verification of those onsite carbon stocks within the following year. No transactions will be allowed until the reversal is verified.

3. Within two years of receiving the Avoidable Reversal notice, the Forest Owner must retire a quantity of CRTs determined according to the formula in Equation 6.6.1. for each vintage affected by the reversal. Project registration and transaction activities will be suspended until the required amount of CRTs is retired.

4. Failure to compensate within the stated time will result in restitution as defined within the contract securing the carbon.

6.2.3 Role of Monitoring, Reporting, and Verification in the Finding of a Reversal

A reversal can be identified through monitoring by Forest Owners and/or during full verifications by third-party verifiers. Since Forest Owners are responsible to maintain current inventories of onsite carbon stocks and submitting Annual Monitoring Reports, a reversal can be identified by a Forest Owner as part of updating their inventory estimates for growth, harvest, and any other disturbances. Third-party verifiers can identify a reversal by a finding that the inventory is incorrectly characterized in the monitoring report; verifiers should be observant to disturbances while in the process of verifying inventory onsite and confirm that any noted disturbances have been properly reported.

6.2.4 The Reserve Buffer Pool

The Buffer Pool is a holding account for CRTs that is administered by the Reserve. All Forest Projects must contribute a percentage of CRTs to the Buffer Pool any time they are issued CRTs for obligated carbon. Each Forest Project contribution is determined by Equation 6.3, as described in the following sections. If a Forest Project experiences an Unavoidable Reversal of GHG removals, the Reserve will retire a number of CRTs as indicated in Section 6.2.1. Contributions are also required from each project for Avoidable Reversal risks to ensure the program remains whole in the event Avoidable Reversals are not compensated by a Forest Owner. The Buffer Pool acts as a general insurance mechanism against reversals for all Forest Projects registered with the Reserve.

6.2.4.1 Determination of Buffer Pool Contribution

Forest Owners must apply a risk reduction to their Forest Project to account for project risks associated with wildfire, disease or insects, and hurricanes or other natural disturbances. The credits associated with the Buffer Pool are used primarily for reversals associated with natural disturbances, but the Reserve may use the pool at its discretion for any reversal that may occur. The project's contribution to the Buffer Pool is a default deduction and is calculated as shown in Equation **6.6.2.** Contribution of Project Credits to Buffer Pool.

Equation 6.6.2. Contribution of Project Credits to Buffer Pool

Contribution to Buffer Pool $_{RP\ Y}$	**=**	***0.08 x Net CRTs,*** $_y$
Where,		
Net CRTs, $_y$	=	Carbon secured (through contractual agreement or maintenance, net of confidence deductions and leakage adjustments) and verified in Reporting Period *y*; refer to description in Section 5.1

6.3 Disposition of Forest Projects after a Reversal

If a reversal lowers the Forest Project actual standing live or dead carbon stocks below its approved baseline standing live or dead carbon stocks, the Forest Project will automatically be terminated. In this circumstance, the original approved baseline for the project would no longer be valid. If the Forest Project is automatically terminated due to an Unavoidable Reversal, another project may be initiated and submitted to the Reserve for registration on the same Project Area. New projects may not be initiated on the same Project Area if the Forest Project is terminated due to an Avoidable Reversal.

If the Forest Project has experienced a reversal and its actual standing live or dead carbon stocks are still above the approved baseline levels, it may continue without termination as long as any reversal of secured CRTs has been compensated. The project must continue contributing to the Buffer Pool in future years based on Equation 6.3.

Appendix A. Fourth Environmental Safeguard: Project Area Monitoring

To meet the requirements of the 4th Environmental Safeguard Forest Projects with improved forest management, restoration, agroforestry, silvopastoral, and reforestation activities must monitor forest land cover throughout the Project Area. Forest land cover outside of the Activity Areas within the Project Area must not decrease as a result of human activities over the Project Life. If a decline in forest land cover greater than 5% is detected relative to the project Start Date during a full verification, the project must rectify the forest cover loss in the subsequent 6 Reporting Periods.

The Fourth Environmental Safeguard analysis is used to evaluate leakage within the Project Area, whereas the Secondary Effects analysis (See Section 5.5) is used to evaluate leakage outside of the Project Area.

Conducting ongoing Project Area monitoring is based on the development of estimates of area in various land cover classes using remotely sensed imagery. The methodology to assess compliance with the 4th Environmental Safeguard involves the following steps, further detailed in the sections below:

1. Select randomized points throughout the Project Area using the i-Tree Canopy Tool
2. Determine if each point is forest land cover using photo images (Google Earth)
3. Import the data into CALCBOSK and generate the Forest Land Cover Report

To comply with the 4th Environmental Safeguard, a review of the forest land cover within the Project Area must be conducted and the corresponding monitoring report must be prepared and submitted for every full verification.

A.1 Establishing Randomized Points

Randomized points are placed throughout the Project Area using the United States Forest Service's i-Tree Canopy Tool.[3] The Reserve will accept, and may approve, proposals of alternative methods of installing random points and/or measuring land cover and canopy cover.

The Project Area is input as the area of interest in the i-Tree Canopy Tool. The Project Area must be imported as a GIS shapefile into the i-Tree Canopy Tool. The i-Tree Canopy Tool will create random points on an aerial photo of the Project Area. The i-Tree Canopy tool automatically calculates the confidence of the estimate of canopy cover. The effort of sampling with random points must continue until the standard error for average canopy cover is less than +/-10% of the mean. The points must be archived for the Project Life and made available to verifiers during verification.

For further guidance, see the MFP Quantification Tools User Manual.

[3] http://www.itreetools.org/canopy/.

A.2 Determine Forest Land Cover

To determine the current forest land cover, the most recent photo image from publicly available sources (Google Earth, etc.) must be used; however, publicly available images from current and past years and other verifiable sources, such as local knowledge of management history, may be used to further inform the decision of land cover type. The analysis of current forest land cover is conducted using the random points established in the previous step. For further information on how to export the random points selected by i-Tree Canopy and import the points into Google Earth, see the MFP Quantification Tools User Manual.

For each point, the forest land cover should be classified using a reference area surrounding the point to provide context. The reference area for determining the land cover type of a random point is an approximate $1/10^{th}$ of a hectare surrounding the point; the land cover type should be identified for the defined random point using a pattern in land cover within the reference area for context. It is advisable to use the Google Earth tool to draw a polygon around the point to determine the reference area. As the determination of the reference area and land cover will require a level of subjectivity, the determination will need to be verified; however, the Reserve's default will be to assume that the Project Developer properly determined the reference area and land cover type and the verifier should only flag cases in which there are clear and certain errors by the Project Developer.

Each point must be classified as forest land cover or other by the Project Developer using the standardized land cover keys provided in Table A.1. The criteria listed in Table A.1 must be used when making land cover key assignments. The Project Developer should enter the land cover classification into an excel spreadsheet. The MFP Quantification Tools User Manual provides further guidance on how to structure the spreadsheet to import the forest land cover classifications into CALCBOSK. The land cover key is used by CALCBOSK to calculate the distribution of forest land cover.

Table A.1. Criteria for Assignment of Land Cover Keys

Land Cover	Definition	Land Cover Key
Forest	Land spanning more than 0.5 hectares with trees that have the potential to grow higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ and that allows for management of one or more forest resources, including timber, fish and wildlife, biodiversity, water quality, recreation, aesthetics, and other public benefits.	FO
Other	All non-forest land cover types	OT

A.3 Generate Forest Land Cover Report

The Project Developer must import the data into CALCBOSK. The MFP Quantification Tools User Manual provides guidance on how to import the table into CALCBOSK. Once imported into

CALCBOSK, the Project Developer can produce the Forest Land Cover Report, which will state the percent forest land cover.

Appendix B. Quantifying Carbon Stocks in Activity Areas: Intensive Inventory Quantification Methodology

Quantification of Activity Areas requires a forest inventory that produces accurate estimates of the included carbon pools,[4] monitors permanence, and evaluates compliance with environmental safeguards.

All activities that use the intensive inventory quantification methodology must use a database and application that facilitates inventory calculations and monitoring. The database and application is called 'CALCBOSK' and is accessible by contacting the Reserve. In addition, the MFP Quantification Tools User Manual includes further instructions on using CALCBOSK and the other quantification tools referred to throughout this section.

Large Urban Forestry, Reforestation, Restoration and Improved Forest Management Activity Areas must use the intensive inventory methodology. An intensive inventory requires that field sample plots be installed, measurements acquired, and data input into CALCBOSK for analytical purposes. Small Urban Forestry, Agroforestry, and Silvopastoral Activity Areas may alternatively use the inventory methodology in Appendix C.

B.1 Developing Initial Activity Area Inventories

Forest Projects must develop an initial inventory for each Activity Area. The initial inventory is then used to calculate the baseline by back-casting to the Activity Area Start Date (Section B.2), and to calculate the actual carbon stocks for the end of each Reporting Period by growing the inventory forward and/or updating the inventory data through remeasurements (Section B.3). CALCBOSK will automatically grow or degrow the inventory to a selected date (Section B.3). The following steps are required to develop the initial inventory:

1. Develop inventory sample plots (Section B.1.1)
2. Calculate the standing live and dead carbon in the sample plots and expand the carbon per plot to a per hectare basis (Section B.1.2)
3. Calculate the confidence statistics (Section B.1.3)

B.1.1 Sampling Methodology for Activity Areas (Standing Live and Dead Trees)

Inventory sample plots for developing a carbon inventory are only required in Activity Areas for the activities listed above. Inventory sample plots are not required to be measured for those areas within the Project Area but otherwise outside of any Activity Areas.

Where sampling is required, the sampling methodology must be designed to achieve an unbiased inventory estimate with a sample error that does not exceed +/- 20% of the mean at the 90% confidence level for standing live and dead trees based on CO_2e estimates at the Activity Area level. Additionally, a minimum of 30 plots must be sampled in each Activity Area. For Forest Projects with multiple Activity Areas, this targeted standard error is achieved across the entire Forest Project by "aggregating" the Activity Areas. Further guidance for projects with multiple Activity Areas is provided below in Section B.1.1.3.

B.1.1.1 Inventory Sampling Plots

A 25-by-25 meter grid of plot locations must be randomly placed on the Activity Area. This must be conducted separately for each Activity Area that uses the intensive inventory methodology.

[4] See Table 4.1 (GHG Assessment Boundary).

Plots are randomly selected from the pool of plots available in the Activity Area for sampling using the randomization utility within CALCBOSK (see the Quantification Tools User Manual for further information). Once the plots have been selected, the Project Developer should inform the Reserve and send a copy of the plot selection to the Reserve. Achieving the overall sampling standard of less than +/- 20% at the 90% confidence level will require a different number of plots based on the variability of stocking within the Activity Area as well as the number of Activity Areas included in the Forest Project.[5] Forest Owners are responsible for estimating the number of plots needed to achieve the confidence statistic minimum standard. Alternatively, plots can be sampled in the order of their random selection until the desired confidence statistic is achieved.

Once the plots have been selected, the inventory plots will be monumented for future re-measurement as part of ongoing monitoring. A map of the sampled plots should be submitted with the Project Report. Additional plots may be added in the future in the order of their random selection at the Activity Area initiation in order to improve confidence estimates. A plot cannot be removed once it is part of the basis of the inventory[6]. CALCBOSK will calculate the inventory confidence from the Activity Area data. The Quantification Tools User Manual provides further guidance on how to generate the report to check the inventory confidence.

Data from inventory plots are valid for a period of 12 years following field sampling, during which time the plot data can be updated (using CALCBOSK) with estimates of annual growth increment to both diameter and height measurements. The process for updating plots is described in detail in Section B.3. Since plot data can be no older than 12 years, plots must be periodically re-measured or new plots installed for both annual monitoring and periodic field verification. Any time more plots are desired for improving inventory confidence, new inventory plots must be selected randomly for measurement from the grid of potential plots described above. Plot data (not plot location) must be removed or replaced from the inventory when an event substantially changes the forest cover surrounding the plot, e.g. harvest or forest fire.

Inventory plots are installed as fixed radius plots. The size of the radius varies depending on the attribute that is measured, as shown in Table B.1. **Inventory Plots** below. Only the random plots selected for sampling need to be installed. Plot centers must be monumented so they can be relocated for future measurement or for verification. Monumenting plot locations so that they are available for re-measurement and/or verification can be challenging. GPS coordinates must be recorded for each plot at, or offset from, the plot center. Since GPS coordinates will only partially assist in relocating the plot center, additional navigational devices are necessary. It is recommended that an object be placed at plot center that is highly resistant to environmental features, including weather, animals, and fire. A small piece of metal rebar may be suitable. Relocating the plot center can be enhanced through the identification of bearing trees, or trees with aluminum tags affixed to them with a measured distance and compass bearing to the plot center etched or otherwise written on them. A minimum of two trees will assist in triangulating to the plot center. Marking these trees with highly visible paint will also be useful for plot center relocation.

Table B.1 displays the data that are to be collected at each inventory plot. Project Developers may use varying tools or sampling methods; however, all sampled data must be entered into

[5] No projects are accepted if the standard error is greater than +/- 20% at the 90% confidence level.
[6] The Reserve is contemplating future guidance to structure a randomized system of removing and replacing plots.

CALCBOSK to calculate the carbon estimates for the Activity Areas and verifiers must use the sampling methodology as detailed in the protocol.

Special considerations are provided for mangrove forests, such that certain mangrove species do not require height measurements, including *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemose, Conocarpus erectus, or Avicennia bicilor*. In addition, the DBH for *Rhizophora mangle* (mangle rojo) should be taken 30 cm above the highest stilt root. Further exemptions or modifications may be made on a case-by-case basis to be approved by the Reserve.

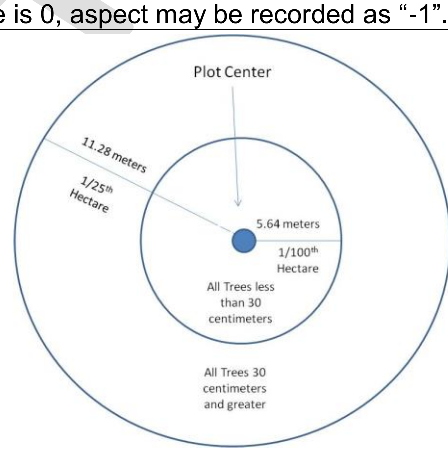
The Quantification Tools User Manual has further guidance on entering the data into CALCBOSK.

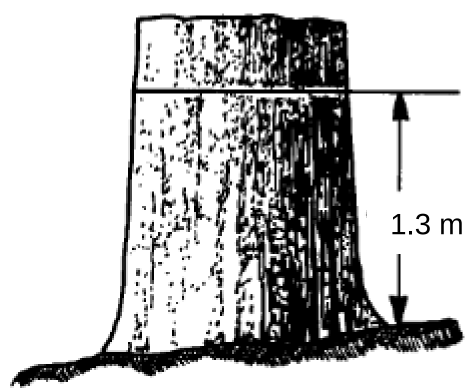
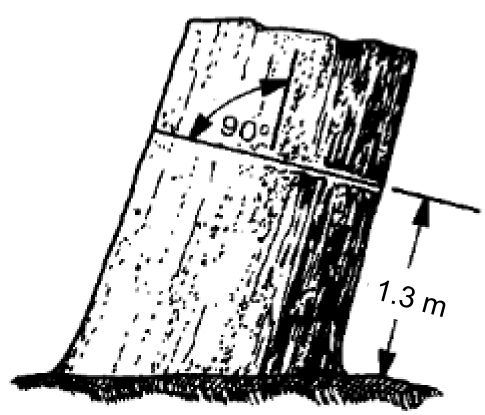
Table B.1. Inventory Plots

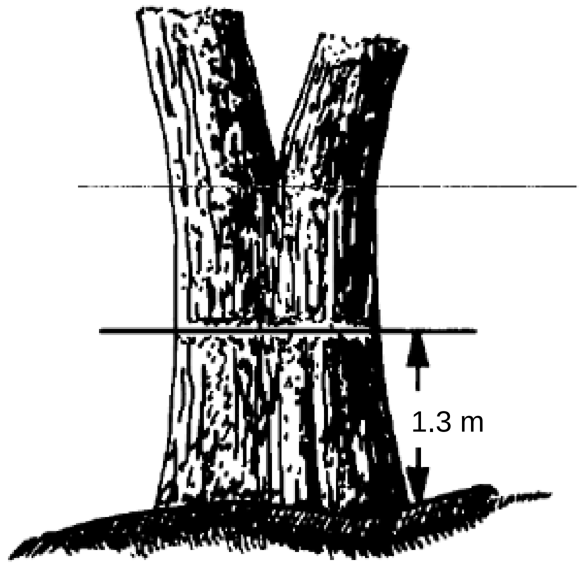
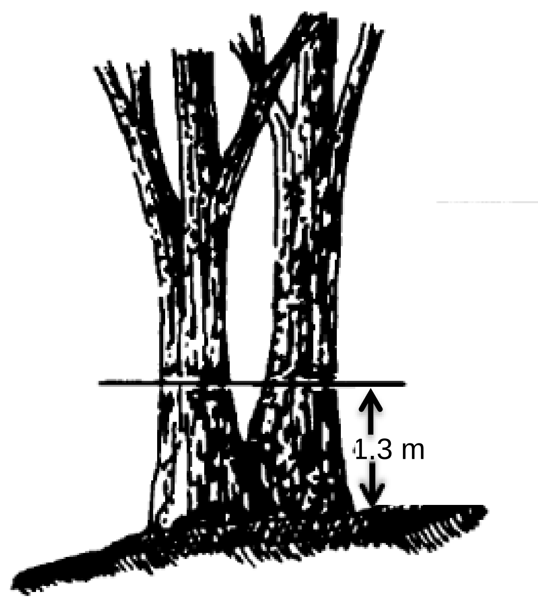
<table>
<tr><th colspan="3">For Each Plot</th></tr>
<tr><th>Item</th><th>Attribute</th><th>Description</th></tr>
<tr><td>1</td><td>Date of Plot Visit</td><td>Day/Month/Year</td></tr>
<tr><td>2</td><td>Latitude</td><td>From GPS (in degrees)</td></tr>
<tr><td>3</td><td>Longitude</td><td>From GPS (in degrees)</td></tr>
<tr><td>4</td><td>Plot Number</td><td>Enter the plot number for the plot, as described in the section above.</td></tr>
<tr><td>5</td><td>Inventory Personnel</td><td>Enter the initials of the inventory technicians responsible for measuring and recording data on the plot.</td></tr>
<tr><td>6</td><td>Slope</td><td>Using the clinometer, average the slope measurements looking uphill and downhill to the nearest 5%.</td></tr>
<tr><td>7</td><td>Aspect</td><td>Enter the degrees (azimuth) looking directly downhill from plot center. If the plot slope is 0, aspect may be recorded as “-1”.</td></tr>
<tr><td colspan="2">On a Fixed 1/25th Hectare Radius (Radius = 11.28 m), all trees ≥ 30 cm DBH and ≥ 3m height

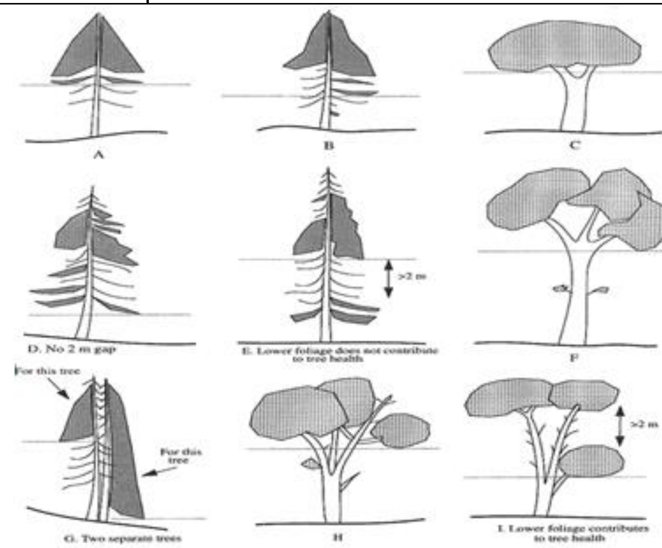
On a Fixed 1/100th Hectare Radius (Radius = 5.64 m), all trees ≥ 5 cm and < 30 cm DBH

Radial measurements need to be corrected for horizontal distances based on the slope from plot center to each tree.

Note: the radial measurements are based on distances from plot center to the base of the tree.</td><td>
</td></tr>
<tr><td>8</td><td>Tree Number</td><td>Trees are assigned a number 1 to X (for ‘large’ trees 30cm and greater) and a letter A to Z (for ‘small’ trees less than 30cm), starting from 0 degrees (North) and generally proceeding clockwise. The numbering convention in CALCBOSK facilitates the relocation and the verification of the trees. Over time, the numbering convention will breakdown as trees grow into plots and small trees with a letter designation grow into large trees with a numeric designation. The following procedures must be adhered to with the numbering convention:</td></tr>
</table>

Item	Attribute	Description
		1. Previously measured small trees that are now measured as large trees must be re-numbered during the inventory update with a value 1 to X. Use a numeric value that has not been used for any tree previously. Put a note in the plot notes indicating that the change was made. 2. Small trees that become large trees that were not previously measured (i.e., outside of the 1/25th hectare plot) must be numbered with a value 1 to X. Use a numeric value that has not been used for any tree previously. It is understood and acceptable that the tree identification system will not follow the original clockwise pattern over time. Other than previously measured small trees, never re-attribute a tree's identification.
9	Species	Enter the species code for each species on the plot. The species code can be found for each species in the species list found on CALCBOSK.
10	DBH	Measure and record Diameter at Breast Height (DBH) to the nearest tenth of a centimeter on every tree using a diameter tape and wrapping the tree at a height of 1.3 meters from the base of the tree on the uphill side. The guide here displays how uncommon trees should be measured (use uphill guidance).  

Item	Attribute	Description
		Forked trees above DBH are counted as one tree. Forked trees below DBH are counted as two trees (or however many forked stems exist). Add minimum DBH to be included.  One Tree  Two Trees *Images via FSH 2409.12 USDA Forest Service Timber Cruising Handbook*
11	Total Height	Measure of total height (height from base of tree to top) of all trees in the plot to the nearest tenth of a meter. If the angle from level to the point of measurement exceeds 45 degrees (i.e., 100% or 66 topo), the distance from the measured tree must be increased to reduce the angle. For dead trees with broken tops, estimate the total height (as if the tree were whole) to the nearest

<table>
<tr><th>Item</th><th>Attribute</th><th colspan="3">Description</th></tr>
<tr><td></td><td></td><td colspan="3">meter by comparing the tree to other live trees of similar diameters and species.</td></tr>
<tr><td>12</td><td>Height to Crown Base</td><td colspan="3">

Measure the distance from the base of the tree to the ocularly balanced base of the tree’s crown. See examples above.</td></tr>
<tr><td rowspan="7">13</td><td rowspan="7">Vigor</td><td colspan="3">For each tree, provide a rating of the tree’s apparent vigor. Determination of vigor is based on consideration of color of foliage, crown proportion and appearance, retention of leaves/needles, appearance of apical growth, length between growth whorls, and presence of cavities and fungal growth. The code is assigned based on the following classes:</td></tr>
<tr><td>Code</td><td>Description</td><td>Decay Adjustment (adjustment to wood density)</td></tr>
<tr><td>1</td><td>Very Healthy/Dominant: Crown is full on all sides and crown length is at least 30% of the tree’s length, or the total height of the tree (measured in step 11) minus the height to crown base (measured in step 12) divided by the total height of the tree is at least 30%. Tree crown is generally above other trees around it and it is experiencing minimum competition.</td><td>100%</td></tr>
<tr><td>2</td><td>Healthy/Codominant: Crown may not be full on all sides due to competition with neighboring trees, but has some portion of its crown in full sunlight. Crown is at least 20% of the tree’s length.</td><td>100%</td></tr>
<tr><td>3</td><td>Suppressed: Crown is generally below other trees and has some live foliage, but is on decline.</td><td>100%</td></tr>
<tr><td>4</td><td>Dead with moderate decay: Tree has no remaining foliage. Branches and top are mostly intact and bark is mostly attached to the tree.</td><td>75%</td></tr>
<tr><td>5</td><td>Dead with advanced decay: Tree may exhibit missing top, fungal bodies, missing bark. No remaining foliage exists on the tree’s crown.</td><td>50%</td></tr>
</table>

<table>
<tr><th>Item</th><th>Attribute</th><th colspan="3">Description</th></tr>
<tr><td rowspan="4">14</td><td>Defect Estimate</td><td>Section of Tree</td><td>Standardized Portion of Biomass in each Section of Whole Trees</td><td>Actual portion of defect in each section of tree (Observed as applied to whole tree) Example: 100% if entire portion is missing (i.e. full defect), 0% if no portion is missing (i.e. no defect). 0% defect is the default in CALCBOSK.</td></tr>
<tr><td rowspan="3"></td><td>Top 1/3</td><td>10%</td><td>0 – 100%</td></tr>
<tr><td>Mid 1/3</td><td>30%</td><td>0 – 100%</td></tr>
<tr><td>Bottom 1/3</td><td>60%</td><td>0 – 100%</td></tr>
<tr><td>15</td><td>Previous 5 years' radial increment</td><td colspan="3">These data are used to estimate growth in the forest. This is required in the absence of repeated plot measurements or a viable growth model for each species.

Enter the measurement (millimeters) of the past 5-years' radial growth (from a ring count) on a 'highly or moderately vigorous' tree (vigor codes 1 or 2) and a 'low vigor' tree (vigor code 3; if present) in the plot; select the first feasible trees (some species may not be suitable for measurement) facing north and continuing clockwise.</td></tr>
</table>

B.1.2 Calculating the Carbon in Standing Live and Dead Trees

This section provides a step-by-step approach to calculating the CO_2e inventory in standing live and dead trees. This section applies only to the inventory estimates within the Activity Areas. Developing forest CO_2e estimates from sampling in the Activity Areas must be done according to the following general steps:

1. Calculating the net CO_2e tonnes for standing live and dead trees on a per hectare basis for each plot.
2. Determining the average net CO_2e tonnes for standing live and dead trees by summing the plots and dividing by the number of plots represented.
3. Summing the CO_2e tonnes for the Activity Area.
4. Calculating the Activity Area sampling error and confidence deduction.

The plot data used to calculate the inventories must represent current conditions at the time the inventory is created. The process for updating forest inventories is discussed in Section B.3. CO_2e is calculated for each tree sampled in the plots using equations provided in the Mexico Forest Protocol Equation File available on the MFP website, based on the measured plot data. The CO_2e estimates calculated for each tree are adjusted based on the defect noted for each tree during inventory sampling. The net CO_2e is expanded to a per hectare basis, following the detailed process outlined in Table B.2.. These calculations are automated in CALBOSK.

Table B.2. Calculate the CO_2e Tonnes for each Plot on a per Hectare Basis

Steps	Description	Tools/Process Required	
1	Calculate the cubic volume and biomass (grams) in each tree.	CALCBOSK calculates volume and/or biomass directly from the input variables, usually DBH and total height, from the forest inventory. The equations used by CALCBOSK are published on the Reserve's website.	
2	Convert the biomass to CO_2e tonnes	The biomass estimates from Step 1 are converted to tonnes CO_2e by dividing the biomass estimate (in grams) by 1000, multiplying the quotient by .5 (to convert the value to carbon) and again by 3.67 (to convert the value to CO2e). The product is tonnes CO_2e per tree.	
3	Adjust the tree's CO_2e tonnes based on defect percentages assigned to each tree.	Defect – Bottom 33%	60% **x** CO_2e tonnes in gross tree (Step 2) **x** Defect% (Bottom 33%)
		Defect – Middle 33%	30% **x** CO_2e tonnes in gross tree (Step 2) **x** Defect% (Middle 33%)
		Defect – Top 33%	10% **x** CO_2e tonnes in gross tree (Step 2) **x** Defect% (Top 33%)
		Sum Defect	Sum of CO_2e defect from each step above
		Adjusted CO_2e	CO_2e tonnes (Step 2) – Sum Defect
4	Adjust CO_2e estimate for dead and dying trees	Dead trees are multiplied by .5 and dying trees are multiplied by .75 to account for decomposition that impacts wood densities. All other trees remain unchanged.	
5	Expand the CO_2e tonnes estimate in each tree to a per hectare basis.	Multiply the CO_2e tonnes estimate in each tree by the weight required to represent the plot estimate on a per hectare basis: 25 **x** CO_2e Tonnes (Step 5) for trees sampled in 1/25th hectare radius 100 **x** CO_2e Tonnes (Step 5) for trees sampled in 1/100th hectare radius.	

The individual tree estimates within each Activity Area are summed within each plot and expanded to a per-hectare value. Subsequently, the plot estimates are averaged to obtain a mean estimate for each Activity Area, as shown in Table B.3..

Table B.3. Determine the CO_2e Tonnes for each Activity Area

Steps	Description	Tools/Process Required
7	Calculate the average CO_2e tonnes per hectare in Activity Area X.	Sum the CO_2e estimates from each plot within Activity Area X on a per hectare basis and divide by the number of plots in Activity Area X.
8	Calculate the total CO_2e tonnes in Activity Area X.	Multiply the average estimate of CO_2e tonnes per hectare by the total hectares represented by Activity Area X in the project.

9	Calculate the sampling error for the mean per hectare value of CO_2e tonnes for Activity Area X and determine confidence deduction	The sampling error, calculated at the 90% confidence level, is calculated automatically in CALCBOSK. Confidence deduction is determined as described in Section B.1.3.

B.1.3 Calculating Confidence Statistics

Although Activity Area data will be accepted with sampling errors up to +/- 20% of the mean at the 90% confidence interval, deductions for uncertainty are applied to an Activity Area's inventory if the sampling error exceeds the Target Sampling Error (TSE). The TSE varies depending on the number of Activity Areas involved, whether within a single Forest Project or as part of a project aggregate, as further described below. The uncertainty deduction is applied directly to the inventory of live and dead trees reported as the actual project stocks for the Activity Area, but not to the baseline estimate, thus ensuring a conservative quantification of project benefits.

Credits that are withheld from transactions due to the uncertainty deduction can be recouped when increased sampling effort (usually the addition of more plots) improves the confidence estimate of the inventory. Likewise, inventory estimates that decrease in confidence will result in a reduction of credits available for transaction, which can result in an apparent reversal. In the event of an apparent reversal due to the application of a confidence deduction, the Forest Owner will have one year to improve the inventory estimate. If the sampling error has not been restored to or below the prior value in the course of the year, the project must compensate for the reversal per the guidance on reversals (Section 6.2).

The confidence deduction depends on the number of Activity Areas included in the Forest Project and/or aggregate. The following sections describe how the confidence deduction for a given Activity Area is determined based on the number of Activity Areas and projects involved.

B.1.1.1Projects with One Activity Area

The TSE for an individual Forest Project (i.e., not participating in an aggregate) with only one Activity Area is +/- 5% of the mean CO2e per hectare at the 90% confidence level. If the sampling error is less than +/- 5%, no confidence deduction is applied. If the sampling error exceeds +/-5%, the confidence deduction is determined as outlined in Table B.4.

Table B.4. Determining the Confidence Deduction for an Individual Project with One Activity Area

Actual Project Sampling Error at 90% Confidence Level	Confidence Deduction
≤ 5%	0%
> 5% - ≤ 20%	Actual sampling error % – 5% (to the nearest 1 percent)
> 20%	100% (Account is suspended until corrections are made)

B.1.1.2Projects with Multiple Activity Areas

For Forest Projects with multiple Activity Areas, the TSE for inventory data associated with individual Activity Areas varies on a sliding scale based on the total number of Activity Areas. By recognizing the principle of an improved population-wide sampling error through combination of multiple sampling sub-populations, projects with multiple Activity Areas are able to reduce the sampling intensity, thereby reducing inventory costs, without compromising statistical integrity. Thus, while the TSE is increased for each Activity Area, achieving the adjusted TSE in all Activity Areas would achieve the overall project target of +/- 5% of the mean at the 90% confidence level. The underlying statistical rationale for this approach, including a description of how the sliding scale was determined, is provided in the Reserve Guidelines for Aggregating Forest Projects.[7]

The TSE for individual Activity Areas ranges between +/- 7 to 20 % of the mean at the 90 % confidence level depending on the total number of Activity Areas in the Forest Project as shown in Table B.5 below. The same TSE applies to all Activity Areas in a Forest Project.

Table B.5. Target Sampling Error at the 90 Percent Confidence Level for Activity Areas in a Forest Project with Multiple Activity Areas and for Forest Projects Participating in an Aggregate

Number of Participating Activity Areas in the Forest Project	Target Sampling Error (TSE)
2	7%
3	8%
4	9%
5	10%
6	11%
7	12%
8	13%
9	14%
10	15%
11	16%
12	17%
13	18%
14	19%
15+	20%

The inventory for each Activity Area is evaluated (independent of the inventories for other Activity Areas) to determine if the sampling error exceeds the TSE. If the sampling error for a given Activity Area exceeds the TSE, a confidence deduction is applied to the inventory for that Activity Area. Confidence deductions are determined according to Table B.6 using the appropriate TSE (from Table 3.5). Regardless the TSE, Activity Area inventories with a sampling error greater than +/-20% of the mean at the 90% confidence level will not be accepted.

Table B.6. Inventory Confidence Deductions for Activity Areas in a Forest Project with multiple Activity Areas and for Forest Projects Participating in an Aggregate

Actual Sampling Error at 90% Confidence Level	Confidence Deduction
0 - TSE%	0%
TSE to 20%	(Actual sampling error – TSE %) to the nearest $1/10^{th}$ per cent
Greater than 20%	100%

[7] Available at http://www.climateactionreserve.org/how/protocols/mexico-forest/

B.1.1.3 Projects Participating in an Aggregate

As with individual projects containing multiple Activity Areas, Forest Owners enrolled in an Aggregate may submit project inventories with reduced sampling requirements based on the statistical principle that the overall TSE (+/- 5 % of the mean at the 90 % confidence level) is achieved across the entire aggregate.

The guidance provided in Section B.1.1.2 for projects with multiple Activity Areas also applies to projects participating in an Aggregate. The TSE for all Activity Areas associated with projects in an Aggregate is based on the total number of Activity Areas across all projects participating in the Aggregate. The inventory for each Activity Area is evaluated independently of other Activity Areas, whether associated with the same project or with another project participating in the aggregate. See Table B.5 to determine the TSE applicable to Activity Areas for projects participating in an aggregate. See Table B.6 to determine the confidence deduction to apply to each Activity Area.

Further guidance for Forest Projects included in an Aggregate is provided in the Reserve Guidelines for Aggregating Forest Projects.

B.2 Determining Activity Area Baseline

For Activity Areas that pass the Performance Standard (Section 3.13.2), the baseline is calculated as the sum of carbon inventories in the required pools (tCO_2e) at the Start Date.

Project Developers have the flexibility to postpone their baseline development until their first verification by back-casting an inventory developed within 2 years of the Activity Area Start Date. This gives the Project Developer the flexibility to complete their initial inventory within the first two Reporting Periods (i.e. by the end of the second Reporting Period). The Project Developer then develops an inventory that is representative of the Activity Area's Start Date by back-casting the later developed inventory.

Plot data recorded for the development of the initial inventory may include radial increment data (in the absence of other growth data), which can be used to estimate DBH and tree height at an earlier time. CALCBOSK, the companion data management tool for the Protocol, will back-cast inventory data to the selected project Start Date.

B.3 Updating Activity Area Carbon Inventories and Determining Actual Onsite Carbon Stocks

Since Activity Area forest carbon stock estimates are constantly fluctuating due to additional inventory data, forest growth, harvest, and natural disturbances, estimates of forest carbon stocks must be updated and reported annually. The annual adjustments to inventory data are based on the inclusion of new information, adjusting existing data for forest growth and disturbances, and recalculating the carbon estimates and the confidence deduction.

The inventory of Activity Areas is based on modeling ('growing') the inventory data to the end-of-the reporting period date. The length of time in which the inventory plots are modeled is dependent on the most recent date plot measurements were acquired in the field and input into CALCBOSK. All plots are required to be remeasured within a 12-year timeframe. Each step is described in greater detail below.

B.3.1 Updating Forest Inventory Data Based on New Information

For the Activity Areas, any plots sampled or re-sampled in the past year must be incorporated into the project inventory. If a plot is re-measured, the old data must be replaced with the new data in terms of representing the plot's inventory. Plot data is valid for 12 years, at which point the plot must be re-measured. The Activity Area inventory therefore must be based on plots sampled within the 12-year period. Forest Owners may decide to perform all of their inventory sampling in a given year or distribute it throughout the 12-year timeframe. Forest Owners are advised to inspect the modeled growth estimates with actual field conditions and base their determination of the frequency of updating plots on how well the modeled data tracks with actual conditions. Poor alignment between actual data and modeled data would indicate the need for more frequent field sampling efforts, as full verifications with site visit activities place a high focus on the comparison of data managed in CALCBOSK and actual data measured in the field.

B.3.2 Updating Forest Inventory Data for Growth

The approach to 'growing' trees in CALCBOSK is through the use of near-term (less than 12 year) projections of inventory data based on recent historical growth. Historical radial increment samples are acquired initially from each plot, which are used as the basis for forward projections of diameter. Height measurements are projected forward based on conserving the proportion of diameter to height and adjusting the height based on the modified (grown) diameter. The steps involved are displayed in Table . However, CALCBOSK automates these steps. See the Quantification Tools User Manual for further information on using the automated functionality in CALCBOSK to update the inventory data annually.

Where increment data cannot be acquired from the stated procedures in the inventory manual, the Reserve will work with the Forest Owner to develop an alternative solution. This is usually reserved for hardwoods where radial data cannot be acquired.

Where sufficient sample plots have been remeasured, the growth programming in CALCBOSK will switch to calculating diameter and height increment based on the subsample of remeasured inventory plots. This functionality will engage within 6 to 12 years following the first Reporting Period, depending on how many plots have been remeasured. This method is expected to provide improved growth estimates over the initial approach, since both diameter and height will be projected based on real measurements.

Table B.7. Steps used in CALCBOSK for Updating Tree Records

Steps	Description	Tools/Process Required
1	Querying data for analysis.	Query live tree records by species class (conifer and hardwood), and vigor class in the Activity Area that have been measured for increment. (CALCBOSK assigns size classes to inventory data.)
2	Determine annual diameter increment.	The previously collected data for diameter increment (see item 16 in Table B.1. Inventory Plots Inventory Plots) represent the increment over the previous 5 years. This data must be divided by 5 to determine the average annual diameter increment. Note: In many cases, it is impossible to extract good increment samples from hardwoods. In such cases, the conifer increment is applied to the hardwood trees after adjusting the increment based on a comparison of average hardwood diameter to conifer diameter on a

		plot by plot basis, where tree ages are assumed to be equal.
3	Calculate average annual diameter increment.	The average annual diameter increment by species class and vigor class is calculated by summing the results from Step 2 for each species class and vigor glass and dividing by the number of records summed.
4	Add diameter increment to tree records.	The average diameter increment for each species class and vigor class is multiplied by the number of days between the desired report date and the date the tree record was measured in the field. This adjusts the tree's diameter either forward or backward to a previous or future estimate.
5	Calculate a diameter-to-height regression estimator.	Height adjustments for each tree are based on the tree's diameter/height relationship from field measurements and applying the same relationship to trees with modified diameters from modeling. When the basis of modeled projections switches to an analysis of remeasured trees, whereby both the change in diameter and height can be determined, growth projections will be made by developing both diameter and height increment estimates for each species and vigor class combination.
6	Calculate the estimated height for each tree based on the increment determined from Step 5.	Apply the estimated height increment developed in Step 5 for each tree record to update the tree's height. Like the diameter 'growth', the height change can occur forward or backward looking to a specific desired reporting date.

B.3.3 Updating Forest Inventory Estimate for Harvests and/or Disturbances

Due to real timing challenges in scheduling the development of monitoring reports and accomplishing the fieldwork associated with inventory management, plots that have been modified by harvest and/or natural disturbances since the previous reporting period must be excluded from the inventory analysis until the plots are updated with re-measured data from field visits. No more than 5% of the total inventory plots used to derive the inventory estimate can be excluded for a Reporting Period. Excluded plots are not used to calculate the reported inventory of CO_2e nor are they used to calculate the sampling error. Additionally, an excluded plot must be included in the next year's inventory, meaning the plot must be remeasured within the year prior to the next Reporting Period. Project Developers should submit a list of plots to be excluded for purposes of verification prior to the site visit portion of a full verification.

B.3.4 Completing the Annual Update Process

Upon updating the height and diameter increments, the land use and forest cover classes for disturbances, and the Activity Area (hectare) assignments in CALCBOSK, the forest carbon stocks can be recalculated using the methods identified in Appendix B.1.2. The Quantification Tools User Manual provides further guidance for updating the data in CALCBOSK. The confidence statistics and the associated confidence deduction for each Activity Area may only be updated in the Carbon Monitoring Worksheet for reporting periods undergoing a full verification during which the inventory updates are to be reviewed and approved by a verifier.

Appendix C. Quantifying Carbon Stocks in Activity Areas: Canopy Cover Quantification Methodology

Small Urban Forestry, Agroforestry, and Silvopastoral Activity Areas may use the canopy cover inventory methodology to estimate carbon stocks in live trees. Nevertheless, Project Developers always maintain the option to use the intensive inventory methodology to quantify live tree carbon for all Activity Areas.

For Forest Projects with multiple Activity Areas, quantification of carbon stocks should be conducted independently for each Activity Area. The canopy cover quantification methodology will be used to determine the Activity Area baseline as well as to quantify the actual onsite carbon stocks at the end of each Reporting Period. Section C.3 describes the process for updating the inventory to quantify the actual onsite carbon stocks for each Reporting Period. The canopy cover inventory methodology includes deriving a measurement of the canopy area within the Activity Area, which are applied to ratio estimators to produce an estimate of CO_2e for the Activity Area. Ratio estimators represent a relationship between CO_2e in standing trees and canopy cover, providing the ability to estimate the CO_2e in standing trees across the Activity Area as a function of the Activity Area's overall canopy cover.

The canopy cover inventory methodology must be used to estimate the impacts to shrub carbon stocks resulting from site preparation activities at the start of the project activity that involves the removal of shrub cover on a Reforestation Activity Area. Such estimates are based on a comparison of pre- and post-site preparation shrub cover, as outlined in Section **Error! Reference source not found.**.

C.1 Developing Initial Activity Area Inventories

Default ratio estimators for live tree stocks, for both Agroforestry/Silvopastoral Activity Areas and for Small Urban Forestry Activity Areas, are available on the Reserve's Mexico Forest Project webpage, as are default ratio estimators for shrub stocks. Default ratio estimators are based on published values of above- and below-ground live tree or shrub pools from field studies and are organized by Assessment Area, which are defined geographic areas available on the Reserve's Mexico Forest Project webpage in the format of a map file and also as reference tables. The reference tables include information on the studies used to develop the ratio estimator for each Assessment Area. These tables will be updated as new studies and data become available. Projects determine which Assessment Area(s) their Activity Areas fall in based on activity and a geographic comparison. Project Developers must initiate their project using the most current version of the default values and must maintain these values for the project crediting period.

Default ratio estimators for Small Urban Forestry Activity Areas are integer values representing the amount of CO_2e per hectare of canopy cover. Default ratio estimators for live trees in Agroforestry and Silvopastoral Activity Areas and for shrubs on Reforestation Activity Areas are equations used to estimate the amount of CO_2e per hectare of canopy cover. See Section C.1.1 for a description of how the default ratio estimators for Small Urban Forestry Activity Areas and those for Agroforestry/Silvopastoral (for live trees) and Reforestation (for shrubs) Activity Areas are applied.

Equation C.1 is used to estimate the total tonnes of CO_2e in above- and below-ground live tree biomass in Small Urban Forestry Activity Areas using the canopy cover quantification methodology, whereas Equation C.2 is used for live tree biomass in Agroforestry and

Silvopastoral Activity Areas and for shrub biomass in Reforestation Activity Areas undertaking shrub removal for site preparation.

Equation C.0.1. General equation used to calculate total CO_2e stocks in a Small Urban Forestry Activity Area.

$AC_{onsite,y}$	=	$\sum A_m * C_m * RE_m$	
where,			<u>Units</u>
$AC_{onsite,y}$	=	Onsite carbon stocks	tCO_2e
A_m	=	Total area of Assessment Area *m* within the Activity Area	hectares
C_m	=	Estimated canopy cover for Assessment Area *m* within the Activity Area	%
$RE_{urb,m}$	=	Default Urban Forest ratio estimator for Assessment Area *m*	tCO_2e/hectare

Equation C.0.2. General equation used to calculate total CO_2e stocks in an Agroforestry/Silvopastoral Activity Area (live trees) or in a Reforestation Activity Area (shrubs)

$AC_{onsite,y}$	=	$\sum A_m * RE_m$	
where,			<u>Units</u>
$AC_{onsite,y}$	=	Onsite carbon stocks	tCO_2e
A_m	=	Total area of Assessment Area *m* within the Activity Area	hectares
And,			
$RE_{ag,m}$	=	$D_m * C_m * 100 + 18.4$	tCO_2e/hectare
where,			
C_m	=	Estimated canopy cover for Assessment Area *m* within the Activity Area	%
D_m	=	Ratio of CO_2 in living biomass per 1 percent canopy cover of trees (Agroforestry and Silvopastoral Activity Areas) or shrubs (Reforestation Activity Areas) within Assessment Area *m*	tCO_2e/hectare

The general approach to developing estimates of CO_2e through default ratio estimators for each Activity Area uses the following steps, all of which are described in more detail in this document:

1. Determine the activity and Assessment Area(s) applicable to the Activity Area – see Section C.1.1
2. Select the correct default ratio estimator – see Section C.1.2
3. Develop an estimate of the canopy cover within the Activity Area – see Section C.1.3
4. Apply the canopy cover estimate to the default ratio estimator (multiplying for the Small Urban Forestry Activity Areas and applying as a variable in Equation C.8 for Agroforestry, Silvopastoral, and Reforestation Activity Areas) and multiply by the total hectares of the Activity Area to expand the CO_2e estimate to the Activity Area – see Section C.1.4

For Reforestation Activity Areas requiring an estimate of the impact on shrub carbon stocks resulting from site preparation activities that remove shrub cover, Steps 3 and 4 above are conducted twice—once using a satellite image from prior to the start of site preparation activities and a second time using a satellite image from after the completion of site preparation activities.

C.1.1 Determine the Appropriate Assessment Area Applicable to the Activity Area

Map layers of Assessment Areas (in .shp and .kml formats) applicable to Agroforestry/Silvopastoral Activity Areas, Small Urban Forestry Activity Areas, and Reforestation Activity Areas can be found on the Mexico Forest Project webpage. Project Developers can determine the appropriate Assessment Area(s) by uploading the Activity Area shapefile to mapping software and performing an analysis (such as “Intersect” in ArcGIS) with the Assessment Area layer.

Project Developers shall calculate the number of project hectares for each Assessment Area applicable to the Activity Area. If the Activity Area spans multiple Assessment Areas, identify all applicable Assessment Areas.

Table C.1. Example of Assessment Area and Activity Area Hectares Required in Project Report for a Small Urban Forestry Activity Area

Assessment Area	Number of Activity Area Hectares
Mexico Urban Forest	50

Table C.2. Example of Assessment Area and Activity Area Hectares Required in Project Report for an Agroforestry or Silvopastoral Activity Area

Assessment Area	Number of Activity Area Hectares
Subtropical dry forest	35
Subtropical mountain systems	65

Table C.3. Example of Assessment Area and Project Hectares Required in Project Report for a Reforestation Activity Area

Assessment Area	Number of Activity Area Hectares
Subtropical	15
Tropical	85

C.1.2 Select the Correct Default Ratio Estimator

Use the table of Assessment Areas and its corresponding default ratio estimators to select the default ratio estimator that corresponds with the Assessment Area(s) applicable to your Activity Area. If the Activity Area spans multiple Assessment Areas, identify all applicable default ratio estimators. A table must be presented in the Project Report that provides the data shown in Tables C.4, C.5, and C.6.

As described above and in Equation C.0.1., default ratio estimators for Small Urban Forestry Activity Areas are simple coefficients that are multiplied by the area of canopy cover for each Activity Area. As identified in Equation C.0.2., ratio estimators for Agroforestry, Silvopastoral, and Reforestation Activity Areas are equations in which the percentage canopy cover within each Activity Area is applied before being multiplied by the area of the Activity Area. Table C.4, C.5, and C.6 provide examples of the data that must be included in the Project Report for Small Urban Forestry Activity Areas and Agroforestry/Silvopastoral/Reforestation Activity Areas, respectively.

Table C.4. Example of Assessment Area, Activity Area Hectares, and Ratio Estimator Required in Project Report for a Small Urban Forestry Activity Area

Assessment Area	Number of Small Urban Forest Activity Area Hectares	Default Ratio Estimator (t CO_2e/hectare)
Mexico Urban Forest	50	161

Table C.5. Example of Assessment Area, Activity Area Hectares, and Ratio Estimator Required in Project Report for an Agroforestry or Silvopastoral Activity Area

Assessment Area	Number of Silvopastoral Activity Area Hectares	Default Ratio Estimator (t CO_2e/hectare)*
Subtropical dry forest	35	4.4*C* + 18.4
Subtropical mountain systems	65	3.0*C* + 18.4

*Applied in equation, where *C* = percent canopy cover in Activity Area, multiplied by 100

Table C.6. Example of Assessment Area, Activity Area Hectares, and Ratio Estimator Required in Project Report for a Reforestation Activity Area

Assessment Area	Number of Reforestation Activity Area Hectares	Default Ratio Estimator (t CO_2e/hectare)*
Subtropical	15	1.7*C* + 18.4
Tropical	85	1.8*C* + 18.4

*Applied in equation, where *C* = percent canopy cover in Activity Area, multiplied by 100

C.1.3 Estimating Current Canopy Cover in Standing Trees within the Activity Area

The total canopy of trees must be estimated (via sampling) for each of the Assessment Areas using remotely sensed data throughout the Activity Area. A current satellite image or up-to-date remote sensing data must be used for sampling. The image should be dated within 12 months of the Activity Area Start Date and should be from a month where foliage is present and visible (spring or summer). Contact Reserve staff if no image is available.

For sampling the canopy layer, the sampled portion must be displayed as a layer in a GIS. The following methods are allowed for sampling canopy area:

1. Randomized points developed using the i-Tree Canopy tool derive a ‘hit’ or ‘miss’ (of tree canopy, or shrub canopy for Reforestation Activity Areas) and must be determined by the technician. The points superimposed on the Activity Area allow a percentage of canopy cover, total canopy area, and confidence statistics to be calculated. If a project spans multiple Assessment Areas, the i-Tree estimate process should be completed separately for each Assessment Area.

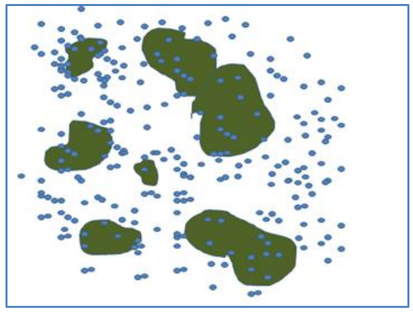


Figure C.1. Example of Overlaying Random Points in the Activity Area to Determine Canopy Percentage

2. A systematic sample can be conducted with a grid of points established in GIS and placed over the Activity Area for the purposes of estimating canopy area. The Project Developer must determine the 'hit' and 'miss' of each point (in terms of being coincident with a tree/shrub crown or multiple tree/shrub crowns), which will enable a percentage of canopy cover to be determined and total canopy area to be determined (as described above). If an Activity Area spans multiple Assessment Areas, this process should be completed separately for each Assessment Area.

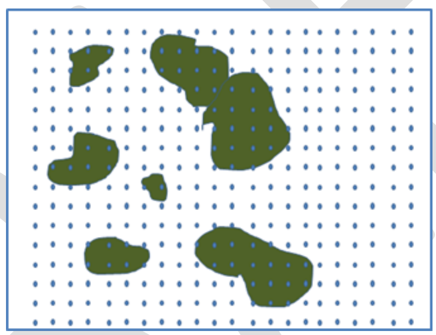


Figure C.2 Example of Overlaying a Systematic Grid in the Activity Area to Determine Canopy Percentage

3. Sampling can be conducted using remotely sensed data as a subset of the Activity Area. Again, the sampling must be designed to develop estimates for each Assessment Area independently. The sampling must incorporate randomized strips (two parallel lines with a known distance between them to calculate area) or randomized or systematic area plots. The Project Developer must be able to calculate accurately the area within the strip or plot that is tree/shrub canopy and the area that is not tree/shrub canopy.

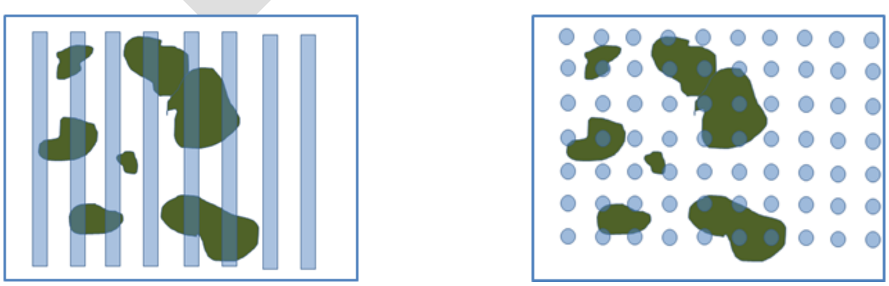


Figure C.3. Example of Overlaying Known Area Sampling Units (Strips and Fixed Radius)

Regardless of the method utilized:

1. The points, strips, or plots must be maintained for the Project Life and be available for verification.

2. Sampling for canopy cover must continue until a confidence estimate for average canopy cover for each Assessment Area is achieved of no greater than +/-5% at 1 Standard Error. Regardless of the sampling method used, a list of point/plots/strips and its corresponding geographic information estimated percentage of canopy cover relative to the Activity Area must be included the Project Report. For example, for projects utilizing randomized points developed using iTree Canopy, a table of cover class, description, latitude and longitude of each point shall be included in the Project Report, as well as a table of estimated percentage of canopy cover by cover class.

   The Reserve does not require that a new set of random points be generated each year. The same points may be applied to an updated image. It is acceptable to augment the set of random points to maintain and/or augment the confidence in the estimate of the canopy cover estimate. However, the confidence level achieved in the first Reporting Period must be met or exceeded in future Reporting Periods.

3. A table must be presented in the Project Report that provides the data shown in Tables C.7, C.8, and/or C.9. Data shall be carried out to two decimal points. The mean percent canopy estimate from sampling is multiplied by the area within each Activity Area, corresponding to each Assessment Area, to estimate the canopy area.

Table C.7. Example of Canopy Cover Data Required in a Small Urban Forestry Activity Areas

Assessment Area	(A) Total Area within Activity Area	(B) Mean Estimate of Canopy Cover at 90% Confidence Level	(C) Total Area of Tree Canopy within Activity Area
	(hectares)		(hectares)
Mexico Urban Forest	50	11%	5.5

Table C.8. Example of Canopy Cover Data Required in an Agroforestry or Silvopastoral Activity Area

Assessment Area	(A) Total Area within Activity Area	(B) Mean Estimate of Canopy Cover at 90% Confidence Level
	(hectares)	
Subtropical dry forest	35	18%
Subtropical mountain systems	65	35%

Table C.9. Example of Canopy Cover Data Required in a Reforestation Activity Area

Assessment Area	(A) Total Area within Activity Area	(B) Mean Estimate of Canopy Cover at 90% Confidence Level
	(hectares)	
Subtropical	15	40%
Tropical	85	55%

In the examples shown above, column B represents the canopy cover estimate derived using one of the methods described above, by Assessment Area. The value in column A represents the total size of the Activity Area within that Assessment Area. For Small Urban Forestry Activity Areas, Column C (the total area of tree canopy within the Activity Area) is generated by multiplying column A by column B. These final numbers are then used to calculate project CO_2e, as described below.

C.1.4 Determining the Activity Area Estimate of CO_2e

With the canopy cover estimated and ratio estimators selected for each of the applicable Assessment Areas, an estimate of CO_2e for the Activity Area can be estimated. The ratio estimators are applied to the canopy cover estimates in each Assessment Area and summed to determine the estimated CO_2e in the Activity Area, as described in Equation C.0.1. and Equation C.0.2. and shown in Tables C.10, C.11 and C.12.

Table C.10. Example of Expanding Ratio Estimators Based on Canopy Cover Area to Estimate Total CO_2e within a Small Urban Forestry Activity Area

Assessment Area	Estimated Canopy Cover Area (from Table C.7)	Ratio estimators (from Table C.4)	Total CO_2e
	(hectares)	(CO2e tonnes/ hectare of canopy cover)	(tonnes)
Mexico Urban Forest	5.5	161	885.5

Table C.11. Example of Expanding Ratio Estimators Based on Canopy Cover Area to Estimate Total CO_2e within an Agroforestry or Silvopastoral Activity Area

Assessment Area	Estimated Canopy Cover Area (from Table C.8)	Ratio estimators* (from Table C.5)	Total Area within Activity Area (from Table C.2)	Total CO_2e
	(percent)	(CO2e tonnes/ hectare of canopy cover)	(hectares)	(tonnes)
Subtropical dry forest	18%	4.4*C* + 18.4	35	3,416
Subtropical mountain systems	35%	3.0*C* + 18.4	65	8,021
Total				**11,437**

**C* = percent canopy cover * 100

Table C.12. Example of Expanding Ratio Estimators Based on Canopy Cover Area to Estimate Total Shrub CO_2e within a Reforestation Activity Area

Assessment Area	Estimated Canopy Cover Area (from Table C.9)	Ratio estimators* (from Table C.6)	Total Area within Activity Area (from Table C.3)	Total CO_2e
	(percent)	(CO2e tonnes/ hectare of canopy cover)	(hectares)	(tonnes)
Subtropical	40%	1.7*C* + 18.4	15	1,296
Tropical	55%	1.8*C* + 18.4	85	9,979
Total				**11,275**

**C* = percent canopy cover * 100

C.1.5 Determining the Initial Change in Shrub CO_2e on Reforestation Activity Areas

The change in shrub carbon stocks at the start of project activities on a Reforestation Activity Area is estimated by calculating the difference between the amount of shrub carbon stocks before the initiation of shrub removal during site preparation and the amount remaining after the completion of site preparation activities. Images used to derive such estimates should be as near to the Activity Area start date as possible while still appropriately representing the 'before' and 'after' conditions. Table C.13 provides an example of the calculation to be performed, using the values from Table C.12 as the 'before' condition. The results from the calculation are entered as the value for the variable $\Delta AC_{shrub,init}$ in Equation 5.1 for the first Reporting Period for the Reforestation Activity Area.

Table C.13. Example of Calculating the Change in Shrub CO_2e Resulting from Site Preparation Activities within a Reforestation Activity Area

Assessment Area	Estimated Canopy Cover Area	Ratio estimators*	Total Area within Activity Area	Total CO_2e
	(percent)	(CO2e tonnes/ hectare of canopy cover)	(hectares)	(tonnes)
Before Shrub Removal				
Subtropical	40%	1.7*C* + 18.4	15	1,296
Tropical	55%	1.8*C* + 18.4	85	9,979
Total				**11,275**
After Shrub Removal				
Subtropical	0%	1.7*C* + 18.4	15	276
Tropical	5%	1.8*C* + 18.4	85	1,573
Total				**1,849**
Change in Shrub CO_2e ('After' – 'Before')				
Total Change ($\Delta AC_{shrub,init}$)				**-9,426**

**C* = percent canopy cover * 100

C.2 Developing Activity Area Baseline

For Small Urban Forestry, Agroforestry, and Silvopastoral Activity Areas, the baseline is calculated as the sum of carbon inventories in the required pools (tCO_2e) at the Start Date. To calculate the carbon inventory at the Start Date, the total canopy of trees must be estimated (Section C.1.3) using a current satellite image dated within 12 months of the Activity Area Start Date. Contact Reserve staff if no image is available.

For Reforestation Activity Areas, the baseline only includes tree carbon stocks at the Start Date, as indicated in Section 0, using the intensive inventory methodology, as indicated in Section 5.1.2 and described in Appendix B. Quantifying Carbon Stocks in Activity Areas: Intensive Inventory Quantification Methodology. Shrub carbon stocks are not included as a component of the baseline.

C.3 Maintaining and Updating Activity Area Inventories

Activity Area inventories must be reported to the Reserve on an annual basis for each Reporting Period. Activity Area inventories are in constant flux due to forest growth and mortality or removal and therefore must be updated on an annual basis for reporting. The inventory must be updated annually through a re-calculation of the canopy area and applying the ratio estimator(s) used for the initial inventory.

It is important to note that the basis of a successful verification depends on alignment (within tolerance bands defined in Section 8.2.3 between verifier data and Project Developer data for each randomly selected plot (selected by verifier), therefore these guidelines do not ensure successful project verification.

It is acceptable to use the previous points used to develop the canopy area and re-evaluate them with updated imagery. It is also acceptable to use newly generated random point to develop a revised estimate on the updated imagery. The image should be dated within 12 months of the end of the Reporting Period and should be from a month where foliage is present and visible (spring or summer). The image used for the end of a Reporting Period must be dated after the image used for the prior Reporting Period or the Start Date for the first Reporting Period. The Project Developer may provide an attestation asserting that no new image update is available for the current year in which case the Reserve will accept the previous year's reported inventory.