# CAPCOA GHG Rx Forestry Protocol #3:

# Forest Project Protocol

(Based on Forestry Project Protocol version 3.3 developed by Climate Action Reserve)

(Approved by the CAPCOA Board on May 1, 2013)

## The following conditions apply for use in the CAPCOA GHG Rx:

1. The protocol allows projects to be located anywhere in the United States of America. Only GHG emission reductions developed from projects within California are eligible for listing in the CAPCOA GHG Rx;

2. Projects occurring after 1/1/07 are eligible unless the reductions are associated with San Joaquin Valley APCD Rule 2301 and a project start date of 1/1/05 may apply;

3. The crediting period for offset projects is limited to 25 years, not 100 years;

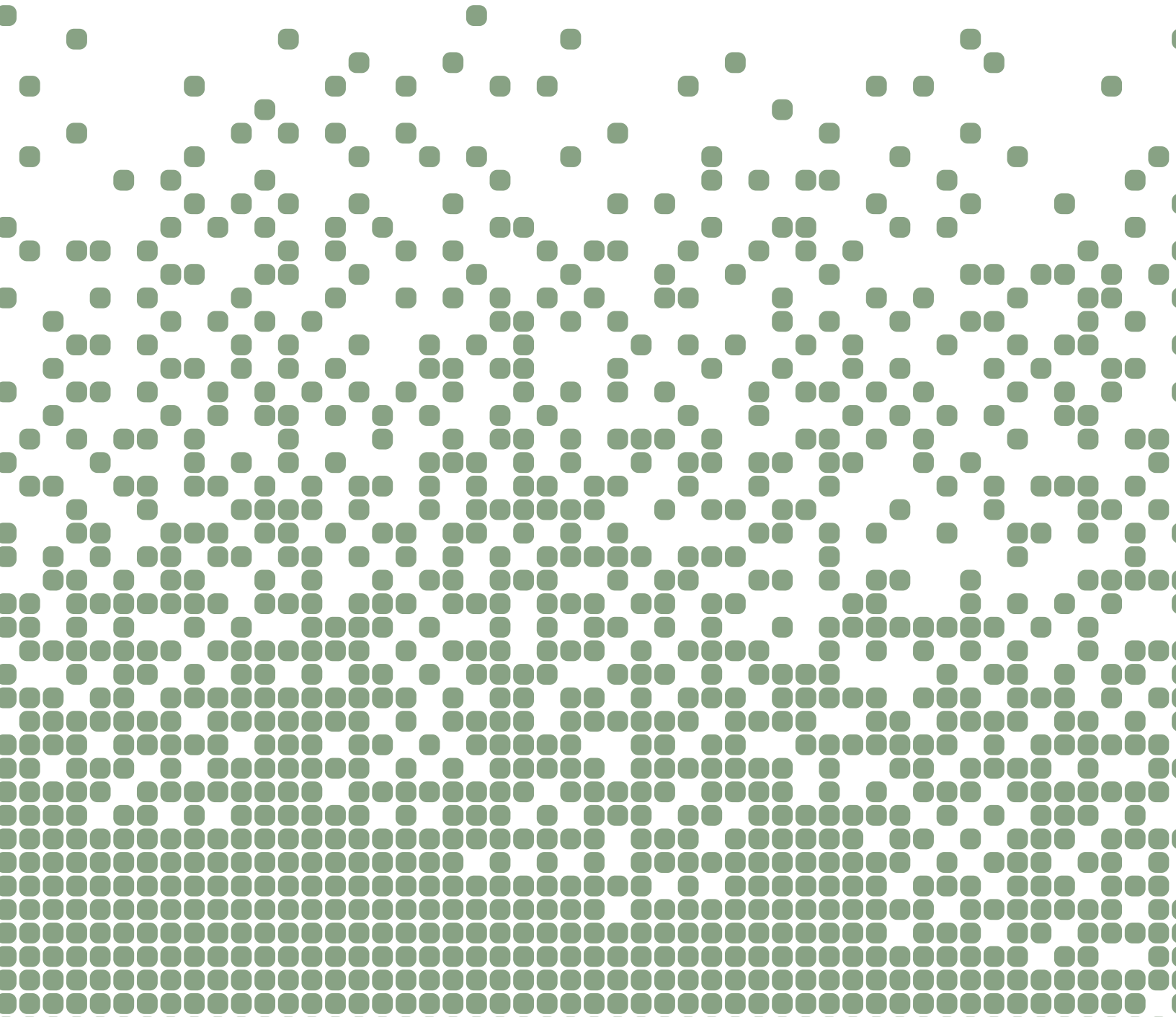
4. Within section 8.3.2.1, CAPCOA has sole authority to defer a project's verification cycle.

CLIMATE ACTION RESERVE

Version 3.3 | November 15, 2012

# Forest

## Project Protocol



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# Abbreviations and Acronyms

| | |
|---|---|
| C | Carbon |
| $CH_4$ | Methane |
| $CO_2$ | Carbon dioxide |
| CRT | Climate Reserve Tonne |
| FIA | USFS Forest Inventory and Analysis[1] |
| FPP | Forest Project Protocol |
| FRAP | CAL FIRE Fire and Resource Assessment Program |
| GHG | Greenhouse gas |
| lb | Pound |
| IFM | Improved Forest Management |
| $N_2O$ | Nitrous oxide |
| PF | Professional Forester, in the case of California, a "Registered Professional Forester" |
| PIA | Project Implementation Agreement |
| Reserve | Climate Action Reserve |
| RPF | Registered Professional Forester, a person registered to practice professional forestry in California |
| USFS | United States Forest Service |

[1] http://fia.fs.fed.us/program-features/rpa/

# 1 Introduction

The Forest Project Protocol (FPP) provides requirements and guidance for quantifying the net climate benefits of activities that sequester carbon on forestland. The protocol provides project eligibility rules; methods to calculate a project's net effects on greenhouse gas (GHG) emissions and removals of $CO_2$ from the atmosphere ("removals"); procedures for assessing the risk that carbon sequestered by a project may be reversed (i.e. released back to the atmosphere); and approaches for long term project monitoring and reporting. The goal of this protocol is to ensure that the net GHG reductions and removals caused by a project are accounted for in a complete, consistent, transparent, accurate, and conservative manner and may therefore be reported to the Climate Action Reserve (Reserve) as the basis for issuing carbon offset credits (called Climate Reserve Tonnes, or CRTs).

The Reserve is a national offsets program working to ensure integrity, transparency and financial value in the North American carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emissions reduction projects in North America; issuing carbon offset credits known as CRTs generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emissions reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market.

Only those Forest Projects that are eligible under and comply with the FPP may be registered with the Reserve. Section 9 of this protocol provides requirements and guidance for verifying the performance of project activities and their associated GHG reductions and removals reported to the Reserve.

## 1.1 About Forests, Carbon Dioxide, and Climate Change

Forests have the capacity to both emit and sequester carbon dioxide ($CO_2$), a leading greenhouse gas that contributes to climate change. Trees, through the process of photosynthesis, naturally absorb $CO_2$ from the atmosphere and store the gas as carbon in their biomass, i.e. trunk (bole), leaves, branches, and roots. Carbon is also stored in the soils that support the forest, as well as the understory plants and litter on the forest floor. Wood products that are harvested from forests can also provide long term storage of carbon.

When trees are disturbed, through events like fire, disease, pests or harvest, some of their stored carbon may oxidize or decay over time releasing $CO_2$ into the atmosphere. The quantity and rate of $CO_2$ that is emitted may vary, depending on the particular circumstances of the disturbance. Forests function as reservoirs in storing $CO_2$.Depending on how forests are managed or impacted by natural events, they can be a net source of emissions, resulting in a decrease to the reservoir, or a net sink, resulting in an increase of $CO_2$ to the reservoir. In other words, forests may have a net negative or net positive impact on the climate.

Through sustainable management and protection, forests can also play a positive and significant role to help address global climate change. The Reserve's FPP is designed to address the forest sector's unique capacity to sequester, store, and emit $CO_2$ and to facilitate the positive role that forests can play to address climate change.

# 2 Forest Project Definitions and Requirements

For the purposes of the FPP, a Forest Project is a planned set of activities designed to increase removals of $CO_2$ from the atmosphere, or reduce or prevent emissions of $CO_2$ to the atmosphere, through increasing and/or conserving forest carbon stocks.

A glossary of terms related to Forest Projects is provided in Section 10 of this protocol. Throughout the protocol, important defined terms are capitalized (e.g. "Reforestation Project").

## 2.1 Project Types

The Reserve will register the following types of Forest Project activities.

### 2.1.1 Reforestation

A Reforestation Project involves restoring tree cover on land that is not at optimal stocking levels and has minimal short-term (30 years) commercial opportunities. A Reforestation Project is only eligible if:

1. The project involves tree planting or removal of impediments to natural reforestation, on land that:
    a. Has had ten percent or less tree canopy cover for a minimum of ten years; or
    b. Has been subject to a Significant Disturbance that has removed at least 20 percent of the Project Area's live biomass in trees.
2. No rotational harvesting of reforested trees or any harvesting of pre-existing carbon in live trees occurs during the first 30 years after the project start date unless such harvesting is needed to prevent or reduce an imminent threat of disease. Such harvesting may only occur if the Project Operator provides the Reserve with a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the harvesting is necessary to prevent or mitigate disease.
3. The tree planting, or removal of impediments to natural reforestation, does not follow a commercial harvest of healthy live trees that has occurred in the Project Area within the past ten years, or since the occurrence of a Significant Disturbance, whichever period is shorter.
4. The project does *not* employ broadcast fertilization.
5. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

A Reforestation Project may involve subsequent tree harvesting and other silvicultural activities.

Reforestation Projects may be eligible on both private and public lands.

### 2.1.2 Improved Forest Management

An Improved Forest Management Project involves management activities that maintain or increase carbon stocks on forested land relative to baseline levels of carbon stocks, as defined in Section 6.2 of this protocol. An Improved Forest Management Project is only eligible if:

1. The project takes place on land that has greater than ten percent tree canopy cover.

2. The project employs natural forest management practices, as defined in Section 3.11.2 of this protocol.
3. The project does *not* employ broadcast fertilization.
4. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

Eligible management activities may include, but are not limited to:

- Increasing the overall age of the forest by increasing rotation ages.
- Increasing the forest productivity by thinning diseased and suppressed trees.
- Managing competing brush and short-lived forest species.
- Increasing the stocking of trees on understocked areas.
- Maintaining stocks at a high level.

Improved Forest Management Projects may be eligible on both private and public lands.

### 2.1.3 Avoided Conversion

An Avoided Conversion Project involves preventing the conversion of forestland to a non-forest land use by dedicating the land to continuous forest cover at existing or increased stocking levels through a conservation easement or transfer to public ownership. An Avoided Conversion Project is only eligible if:

1. The Project Operator can demonstrate that there is a significant threat of conversion of project land to a non-forest land use by following the requirements for establishing the project's baseline in Section 6.3 of this protocol.
2. The project does *not* employ broadcast fertilization.
3. The project does not take place on land that was part of a previously registered Forest Project, unless the previous Forest Project was terminated due to an Unavoidable Reversal (see Section 7).

An Avoided Conversion Project may involve tree planting, harvesting, and other silvicultural activities as part of the project activity.

Avoided Conversion Projects are eligible only on lands that are privately owned prior to the project start date.

## 2.2 Forest Owners and Project Operators

A Forest Owner is an individual or a corporation or other legally constituted entity, city, county, state agency, or a combination thereof that has legal control of any amount of forest carbon[2] within the Project Area. Control of forest carbon means the Forest Owner has the legal authority to effect changes to forest carbon quantities, e.g., through timber rights or other forest management or land-use rights. Control of forest carbon occurs, for purposes of satisfying this protocol, through fee ownership and/or deeded encumbrances, such as conservation easements.

Multiple Forest Owners may exist with respect to a single Forest Project, since control of forest carbon may be associated with fee ownership or through one or more deeded encumbrances that exist within a Project Area, any one of which may convey partial control of the project's

[2] See definition of Forest Carbon in glossary.

forest carbon. Any unencumbered forest carbon is assumed to be controlled by the fee owner. Individuals or entities holding mineral, gas, oil, or similar *de minimis*[3] interests in the forest carbon, are precluded from the definition of Forest Owner.

A Project Operator must be one of the Forest Owners. The Project Operator is responsible for undertaking a Forest Project and registering it with the Reserve, and is ultimately responsible for all Forest Project reporting and attestations. The Project Operator executes the Project Implementation Agreement (see Section 3.5) with the Reserve.

Where any Forest Owner chooses to exclude the forest carbon it controls from becoming part of the Forest Project, the project's baseline must demonstrate the exclusion as a legal constraint.

In all cases, the Project Operator must secure an agreement from all other Forest Owners that (1) assigns authority to the Project Operator to undertake a Forest Project, subject to any conditions imposed by any of the other Forest Owners to include or disallow any carbon they control; and (2) waives any right on the part of the Forest Owners to seek damages, penalties, costs, losses, expenses, or judgments from the Reserve arising from or in any way connected with the Forest Project, except as explicitly provided for in the PIA.

The Reserve maintains the right to determine which individuals or entities meet the definition of "Forest Owner."

The Project Operator may engage an independent third-party project developer to assist or consult with the Project Operator and to implement the Forest Project. All information submitted to the Reserve on behalf of the Project Operator shall reference the Project Operator, who is responsible for the accuracy and completeness of the information submitted, and for ensuring compliance with this Forest Project Protocol.

[3] *de minimis* control includes access right or ways and residential power line right of ways.

# 3 Eligibility Rules and Other Requirements

In addition to the definitions and requirements described in Section 2, Forest Projects must meet several other criteria and conditions to be eligible for registration with the Reserve, and must adhere to certain requirements related to their duration and crediting periods.

## 3.1 Additionality

The Reserve strives to register only projects that yield surplus GHG emission reductions and removals that are additional to what would have occurred in the absence of a carbon offset market (i.e. under "Business As Usual"). For a general discussion of the Reserve's approach to determining additionality, see the Reserve's Program Manual (available at http://www.climateactionreserve.org/how/program/program-manual/).

Forest Projects must satisfy the following tests to be considered additional:

1. *Legal Requirement Test*. Forest Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from compliance with any federal, state, or local law, statute, rule, regulation, or ordinance. Forest Projects must also achieve GHG reductions and removals above and beyond any GHG reductions or removals that would result from compliance with any court order or other legally binding mandates including management plans (such as Timber Harvest Plans) that are required for government agency approval of harvest activities.

   Deeded encumbrances, such as timber deeds or conservation easements, may effectively control forest carbon, such that there may be multiple Forest Owners within the Project Area. Deeded encumbrances are considered legally binding mandates for the purposes of the legal requirement test, unless they are recorded within a year of the Forest Project's start date with clear agreement from all Forest Owners.

   Deeded encumbrances may contain terms that do not directly refer to forest carbon, but that nevertheless restrict the effect the ability of any one Forest Owner to change forest carbon stocks. These terms must be interpreted with respect to their effect on forest carbon for the purposes of the legal requirement test and baseline determinations. Where the terms of deeded encumbrances are not explicit with regards to forest carbon, the following assumptions shall be made:
   - Restrictions or references related to canopy cover, basal area, density, volume, carbon or biomass apply to standing live and dead trees of all species.
   - Carbon in other pools (soil, litter, duff, shrubs, etc.) is assumed to be associated with the other defined terms, such as trees.
   - Terms related to forest (tree) growth apply to growth in all tree species.

2. *Performance Test*. Forest Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from engaging in Business As Usual activities, as defined by the requirements described below (Section 3.1.2).

### 3.1.1 Legal Requirement Test

The legal requirement test is satisfied if the following requirements are met, depending on the type of Forest Project.

#### 3.1.1.1 Reforestation Projects

At the Forest Project's initial verification, the Project Operator must sign the Reserve's Attestation of Voluntary Implementation form indicating that the project's reforestation activities are not legally required (as defined above) and were not legally required at the time of the project's start date.

Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.1 of this protocol.

#### 3.1.1.2 Improved Forest Management Projects

At the Forest Project's initial verification, the Project Operator must sign the Reserve's Attestation of Voluntary Implementation form indicating that the Forest Project is not legally required (as defined above) and was not legally required at the time of the project's start date. For the purposes of the attestation, the "Project" is defined as maintaining onsite carbon stocks at their current levels (at the time the attestation is signed) for at least 100 years.

Modeling of the project's baseline carbon stocks must reflect all legal constraints in effect at the time of the project's start date, as required in Section 6.2 of this protocol.

#### 3.1.1.3 Avoided Conversion Projects

At the Forest Project's initial verification, the Project Operator must sign the Reserve's Attestation of Voluntary Implementation form indicating that the Forest Project's planned forest conservation activities are not legally required (as defined above) and were not legally required at the time of the project's start date.

Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.3 of this protocol.

### 3.1.2 Performance Test

The performance test is satisfied if the following requirements are met, depending on the type of Forest Project.

#### 3.1.2.1 Reforestation Projects

A Reforestation Project that occurs on land that has had ten percent or less tree canopy cover for at least ten years automatically satisfies the performance test.

A Reforestation Project that occurs on land that has undergone a Significant Disturbance satisfies the performance test if:

1. The Forest Project corresponds to a scenario in Appendix B, Table B.1, indicating that it is "eligible" (as determined by the guidance in Appendix B); or
2. The Forest Project occurs on a type of land that has not historically been involved in or allowed timber harvesting. (Examples of such land include municipal or state parks.)

#### 3.1.2.2 Improved Forest Management Projects

An Improved Forest Management Project automatically satisfies the performance test. (Project activities are considered additional to the extent they produce GHG reductions and/or removals in excess of those that would have occurred under a Business As Usual scenario, as defined by the baseline estimation requirements in Section 6.2.1.)

#### 3.1.2.3 Avoided Conversion Projects

An Avoided Conversion Project satisfies the performance test if the Project Operator provides a real estate appraisal for the Project Area (as defined in Section 4) indicating the following:

1. *The Project Area is suitable for conversion*. The appraisal must clearly identify the highest value alternative land use for the Project Area and indicate how the physical characteristics of the Project Area are suitable for the alternative land use.
2. The appraisal must conform with the following minimum standards[4]:
    a. Appraisal reports shall be prepared and signed by a Licensed or Certified Real Estate Appraiser in good standing.
    b. Appraisal reports shall include descriptive photographs and maps of sufficient quality and detail to depict the subject property and any market data relied upon, including the relationship between the location of the subject property and the market data.
    c. Appraisal reports shall include a complete description of the subject property land, site characteristics and improvements. Valuations based on a property's development potential shall include:
        i. Verifiable data on the development potential of the land (e.g. Certificates of Compliance, Tentative Map, Final Map).
        ii. A description of what would be required for a development project to proceed (e.g. legal entitlements, infrastructure).
        iii. Presentation of evidence that sufficient demand exists, or is likely to exist in the future, to provide market support for the development.
        iv. Where conversion to commercial, residential, or agricultural land uses is identified as the highest value alternative land use, the appraisal must demonstrate that the slope of Project Area land is compatible with the alternative land use by identifying two areas with similar average slope conditions to the Project Area that have been converted within the past ten years in the project's Assessment Area. Alternatively, the Project Area must have an average slope less than 40 percent.
        v. Where conversion to agricultural land use is anticipated, the appraisal must provide:
            1. Evidence of soil suitability for the type of expected agricultural land use.
            2. Evidence of water availability for the type of expected agricultural land use.
            3. Where conversion to mining land use is anticipated, the appraisal must provide evidence of the extent and amount of mineral resources existing in the Project Area.
        vi. Where conversion to residential, commercial, or recreational land uses is anticipated, the appraisal must also describe the following information:
            1. The proximity of the Project Area to metropolitan areas
            2. The proximity of the Project Area to grocery and fuel services and accessibility of those services
            3. Population growth within 180 miles of the Project Area
    d. Appraisal reports shall include a statement by the appraiser indicating to what extent land title conditions were investigated and considered in the analysis and value conclusion.

[4] Adapted from Sections 5096.501 and 5096.517, Public Resources Code, State of California.

e. Appraisal reports shall include a discussion of implied dedication, prescriptive rights or other unrecorded rights that may affect value, indicating the extent of investigation, knowledge, or observation of conditions that might indicate evidence of public use.
f. Appraisal reports shall include a separate valuation for ongoing forest management prepared and signed by a certified or registered professional qualified in the field of specialty interest. This valuation shall be reviewed and approved by a second qualified, certified or registered professional, considered by the appraiser, and appended to the appraisal report. The valuation must identify and incorporate all legal constraints that could affect the valuation of both the ongoing forest management.
g. The appraisal must provide a map that displays specific portions of the Project Area that are suitable for the identified alternative land use. (For example, an appraisal that identified a golf course as an alternative land use must specify the approximate acres suitable for fairways, greens, clubhouses, and outbuildings.). The smaller of the two areas identified in the appraisals must be used.

3. *The alternative land use for the Project Area has a higher market value than maintaining the Project Area for sustainable forest management.* The appraisal for the property must provide a value for the current forest land use condition of the Project Area and a fair market value of the anticipated alternative land use for the Project Area. The anticipated alternative land use for the Project Area must be at least 40 percent greater than the value of the current forested land use.

The appraisals must be conducted in accordance with the Uniform Standards of Professional Appraisal Practice[5] and the appraiser must meet the qualification standards outlined in the Internal Revenue Code, Section 170 (f)(11)(E)(ii).[6]

## 3.2 Project Start Date

The start date of a Forest Project is the date on which an activity is initiated that will lead to increased GHG reductions or removals relative to the Forest Project's baseline. The following actions identify the project start date for each project type:

- For a Reforestation Project, the action is the planting of trees, the removal of impediments to natural regeneration, or site preparation for the planting of trees, whichever comes first.
- For an Improved Forest Management Project, the action is initiating forest management activities that increase sequestration and/or decrease emissions relative to the baseline, or transferring the Project Area to public ownership (see further guidance below).
- For an Avoided Conversion Project, the action is committing the Project Area to continued forest management and protection through recording a conservation easement with a provision to maintain the Project Area in forest cover or transferring the Project Area to public ownership where the Project Area will be maintained in forest cover.

[5] The Uniform Standards of Professional Appraisal Practice may be accessed at: http://commerce.appraisalfoundation.org/html/2006%20USPAP/toc.htm

[6] Section 170 (f)(11)(E) of the Internal Revenue Code defines a qualified appraiser as "an individual who:
(I) has earned an appraisal designation from a recognized professional appraiser organization or has otherwise met minimum education and experience requirements set forth in regulations prescribed by the Secretary,
(II) regularly performs appraisals for which the individual receives compensation, and
(III) meets such other requirements as may be prescribed by the Secretary in regulations or other guidance."

Projects must be submitted to the Reserve within 6 months of their project start date.[7]

An Improved Forest Management project's start date must be linked to a discrete, verifiable action that delineates a change in practice relative to the project's baseline. Project Operators may choose to identify one of the following actions:

- Recordation of a conservation easement on the Project Area. The project start date is the date the easement was recorded.
- Transferring of property ownership (to a public or private entity). The project start date is the date of property transfer.
- Submitting the project to the Reserve.[8] The project start date is the date of submittal, provided that the project completes verification within 30 months of being submitted. If the project does not meet this deadline, it must be resubmitted under the latest version of the protocol; it will not retain the initial submittal date and will be subject to any new project start date requirements.

For pre-existing projects submitted by the April 30, 2010 deadline, possible actions denoting the start date, in addition to those described above, include:

- Implementation of a verifiable forest management plan that leads to the increased carbon stocks.
- Engaging in consulting services for the purposes of implementing a carbon project.

Project Operators must affirm the action denoting the project start date by providing documentation. Adequate documentation could include deeds of trust, title reports, conservation easement documentation, dated forest management plans, and/or contracts or agreements.

## 3.3 Project Crediting Period

The baseline for any Forest Project registered with the Reserve under this version of the Forest Project Protocol is assumed to be valid for 100 years. This means that a registered Forest Project will be eligible to receive CRTs for GHG reductions and/or removals quantified using this protocol, and verified by Reserve-approved verification bodies, for a period of 100 years following the project's start date.

## 3.4 Minimum Time Commitment

Project Operators must monitor and verify a Forest Project for a period of 100 years following the issuance of any CRT for GHG reductions or removals achieved by the project. For example, if CRTs are issued to a Forest Project in year 99 following its start date, monitoring and verification activities must be maintained until year 199. All Forest Projects must undergo an initial site visit verification in order to register with the Reserve. After the initial verification all Forest Projects must undergo a site visit verification at least once every six years. The only exception to this rule is for Reforestation Projects, which may defer a second site visit verification beyond six years, at the Project Operator's discretion. The third and subsequent site visit verifications for Reforestation Projects must continue on a six-year cycle.

[7] See the Reserve's Program Manual for requirements for listing a project with the Reserve, available at http://www.climateactionreserve.org/how-it-works/program/program-manual/.

[8] Submitting a project to the Reserve is considered an initiation of a commitment to employ practices that will maintain or grow net carbon stocks for the duration of the FPP's commitment period, per the requirements of the FPP (Section 3.4) and signing the Project Implementation Agreement (PIA).

There are three possible exceptions to this minimum time commitment:

1. A Forest Project automatically terminates if a Significant Disturbance occurs,[9] leading to an Unavoidable Reversal that reduces the project's standing live tree carbon stocks below the project's baseline standing live tree carbon stocks. Once a Forest Project terminates in this manner, the Project Operator has no further obligations to the Reserve.

2. A Forest Project may be voluntarily terminated prior to the end of its minimum time commitment if the Project Operator retires a quantity of CRTs, as specified under Retiring CRTs Following Project Termination, below.

3. A Forest Project may be automatically terminated if there is a breach of certain terms described within the Project Implementation Agreement. Such a termination will require the Project Operator to retire a quantity of CRTs, as specified under 'Retiring CRTs Following Project Termination' below.

**Retiring CRTs Following Project Termination**

1. For a Reforestation or Avoided Conversion Project, the Project Operator must retire a quantity of CRTs from its Reserve account equal to the total number of CRTs issued to the project over the preceding 100 years.

2. For an Improved Forest Management Project, the Project Operator must retire a quantity of CRTs from its Reserve account equal to the total number of CRTs issued to the project over the preceding 100 years, multiplied by the appropriate compensation rate indicated in Table 3.1.

3. In addition:
    a. The retired CRTs must be those that were issued to the Forest Project, or that were issued to other Forest Projects registered with the Reserve.
    b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.

[9] The natural disturbance shall not be the result of intentional or grossly negligent acts of any of the Forest Owners.

**Table 3.1.** Compensation Rate for Terminated Improved Forest Management Projects

| Number of Years that have Elapsed Between the Start Date and the Date of Termination | Compensation Rate |
|---|---|
| 0-5 | 1.40 |
| 6-10 | 1.20 |
| 11-20 | 1.15 |
| 21-30 | 1.10 |
| 31-50 | 1.05 |
| >50 | 1.00 |

## 3.5 Project Implementation Agreement

For a Forest Project to be eligible for registration with the Reserve, the Project Operator is required to enter into a Project Implementation Agreement (PIA) with the Reserve. The PIA is an agreement between the Reserve and a Project Operator setting forth: (i) the Project Operator's obligation (and the obligation of its successors and assigns) to comply with the Forest Project Protocol, and (ii) the rights and remedies of the Reserve in the event of any failure of the Project Operator to comply with its obligations. It is not possible to terminate the PIA for only a portion of the Project Area. The PIA must be signed by the Project Operator before a project can be registered with the Reserve. It must be signed by all entities that are fee simple owners of the Project Area property. The PIA is recorded and submitted after the Reserve has reviewed the verification documents and is about to register the project.

## 3.6 Use of Qualified Conservation Easements or Qualified Deed Restrictions

A Qualified Conservation Easement is a conservation easement that explicitly (1) refers to, and incorporates by reference, the terms and conditions of the PIA agreed to by the Project Operator, thereby binding both the grantor and grantee—as well as their subsequent assignees— to the terms of the PIA for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol; (2) makes all future encumbrances and deeds subject to the PIA; and (3) makes the Reserve a third party beneficiary of the conservation easement.

A Qualified Deed Restriction is a deed restriction that ensures that the Project Implementation Agreement runs with the land and explicitly (1) refers to, and incorporates by reference, the terms and conditions of the PIA agreed to by the Project Operator, thereby Project Operator—as well as their subsequent assignees to the terms of the PIA for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol; (2) makes all future encumbrances and deeds subject to the PIA; and (3) makes the Reserve a third party beneficiary of the deed restriction. A deed restriction is not "qualified" if it merely consists of a recording of the Project Implementation Agreement or a notice of the Project Implementation Agreement, as such a recording is already required by the Project Implementation Agreement. The Reserve maintains the discretion to determine whether a deed restriction meets the terms to be considered a Qualified Deed Restriction.

Qualified Conservation Easements or Qualified Deed Restrictions may be voluntarily employed with any project type. Projects that choose to employ Qualified Conservation Easements or

Qualified Deed Restrictions have reduced obligations to the Reserve's CRT Buffer Pool, as described in Section 7 and Appendix A.

Qualified Conservation Easements and Qualified Deed Restrictions must be recorded no earlier than one year before a project's start date. If a Qualified Conservation Easement or Qualified Deed Restriction was recorded more than one year prior to the start date, the limits imposed by the easement or deed restriction on forest management activities must be considered as a legal mandate for the purpose of satisfying the legal requirement test for additionality (Section 3.1.1) and in determining the project's baseline (Section 6).

## 3.7 Attestation of Title

Each time a Forest Project is verified, Project Operators must sign the Reserve's standard Attestation of Title form indicating that they have an exclusive right to claim to the GHG reductions and removals achieved by their Forest Project over the verification period. Copies of the Attestation of Title form are available on the Reserve's website. Please note that in requesting this form, the Reserve is not providing credit or acting as a broker to trade any Forest Project CRTs.

## 3.8 Project Location

All Forest Projects located in the United States of America are eligible to register with the Reserve provided they meet all other eligibility requirements described in this protocol. Reforestation Projects and Improved Forest Management Projects may be located on private land or on state or municipal public land. Avoided Conversion Projects must be implemented on private land, unless the land is transferred to public ownership as part of the project. All projects can be transferred from private to public lands, whereby the public entity acquires all terms and conditions described in this protocol.

All Improved Forest Management Projects that are on public lands as of the project's start date must be approved by the government agency or agencies responsible for management activities on the land. This approval must include an explicit approval of the project's baseline, as determined in Section 6, and must involve any public vetting processes necessary to evaluate management and policy decisions concerning the project activity.

Forest Projects on federal lands may be eligible if and when their eligibility is approved through a federal legislative or regulatory/rulemaking process. Forest Projects in tribal areas must demonstrate that the land within the Project Area is owned by a tribe or private entities.

Companion documents to Version 3.3 of the Forest Project Protocol contain data tables, equations, and benchmark data applicable to projects located in the United States. The Reserve may add approved equations and models as they are developed in future versions of the Forest Project Protocol.

The methods required by this protocol for estimating baseline carbon stocks for Forest Projects cannot currently be applied outside the United States, as they rely on U.S.-specific data sets and models.

## 3.9 Regulatory Compliance

Each time the Forest Project is verified, the Project Operator must attest that the project is in material compliance with all applicable laws relevant to the project activity. Project Operators

are required to disclose in writing to the verifier any and all instances of material non-compliance of the project with any law. If a verifier finds that a project is in a state of recurrent non-compliance or non-compliance that is the result of negligence or intent, then CRTs will not be issued for GHG reductions that occurred during the period of non-compliance. Non-compliance solely due to administrative or reporting issues, or due to "acts of nature," will not affect CRT crediting.

## 3.10 Forest Project Aggregation

Smaller Forest Projects (less than or equal to 5,000 acres) may be aggregated to improve cost-effectiveness while maintaining rigor in overall carbon inventory accounting. Individual Forest Projects can benefit through participation in an aggregate by meeting carbon inventory confidence standards across an aggregate, rather than within each Project Area. This reduces the sampling intensity required within each Project Area to meet statistical confidence requirements. Similarly, verification of aggregated projects is considered across the broader population, which reduces the verification costs to individual Project Operators participating in an aggregate by approximately 50 percent. An aggregate consists of two or more individual Forest Projects enrolled with an Aggregator.

### 3.10.1 Acreage Limitations

Project Operators may enroll up to 5,000 acres in aggregates, as either a single project or multiple projects. The 5,000-acre limit is triggered by total acreage enrolled by the Project Operator instead of the amount of acreage in any one project or aggregate. A Project Operator can keep up to the first 5,000 acres in an aggregate(s) as long as desired. After 5,000 acres has been enrolled in an aggregate, or aggregates, a Project Operator will need to submit projects on a standalone basis.

In all aggregates, except those formed from two projects, no single project may comprise more than 50 percent of the total combined acreage in an aggregate. This is to prevent any one project from disproportionately affecting the inventory statistics and having excessive influence on the composite sampling error. In the case of aggregates formed from two projects, no single project may comprise more than 70 percent of the total combined acreage in the aggregate.

### 3.10.2 Qualifications and Role of Aggregators

An Aggregator may be a corporation or other legally constituted entity, city, county, state agency, individual or a combination thereof. An Aggregator must have an account on the Reserve. A Project Operator can serve as their own Aggregator or as an Aggregator for a group of projects when they are the Project Operator for one or more of the projects.

An Aggregator must first open an account on the Reserve. An Aggregator must remain in good standing. Failure to remain in good standing will result in all account activities of the participant projects in the aggregate managed by that Aggregator being suspended until issues are resolved to the satisfaction of the Reserve. In order for an Aggregator to remain in good standing, Aggregators must perform as follows:

- Complete aggregation contracts with Project Operators which include mandatory components. (See following section on Joining an Aggregate.)
- Select a single verification body for all Forest Projects enrolled in the Aggregate in any given year or set of years.
- Coordinate the verification schedule which maintains appropriate verification status for the aggregate. Document the verification work and report to the Reserve on an annual

basis how completed verifications demonstrate compliance. (See sections on Monitoring and Verification with regard to Aggregates.)
- Maintain a Reserve account to which CRTs will be transferred from the accounts of participating Project Operators and from which CRTS must be transacted.

Aggregators cannot act as official agents to the Reserve on behalf of Project Operators; Project Operators are ultimately responsible for submitting all required forms and complying with the terms of the FPP. Aggregators may, however, manage the flow of ongoing monitoring and verification reports to the Reserve as a service to Project Operators. Aggregators may also engage in project development, provide inventory services, assist in facilitating verification activities, and provide other services for the Project Operator. The scope of aggregator services would be up to negotiation between Project Operators and the Aggregator and reflected in the contracts between the Project Operator and the Aggregator.

### 3.10.3 Forming an Aggregate

In order to form an aggregate, Aggregators are required to establish a "Broker, Retailer, Trader" account on the Reserve.[10]

Aggregators must also submit an "Aggregator Document" that includes the following information:

- The name, description and contact information of Aggregator.
- Proof of incorporation and/or good standing as corporate entity, or other legally constituted entity, city, county, state agency, individual or a combination thereof.
- A list of initial Project Operator projects which must be greater than one.

The Aggregator Document will be available to the public on the Reserve's website, and will require approval by Reserve staff. It must be modified any time a participant joins or leaves an aggregate (triggered by the submission of an "Aggregate Entry" or "Aggregate Exit" forms as described below).

### 3.10.4 Joining an Aggregate

To join an aggregate, Project Operators will be required to submit an "Aggregate Entry" form. This form may be included at the time of project submittal, or at any time thereafter. This form will require Reserve staff's approval and will contain:

- Statement that the Project Operator wishes to join a specific aggregate with a specific Aggregator. A participating project can only have one Aggregator.
- Copies of any contract(s) between Project Operator and Aggregator relevant to Forest Project monitoring and verification or the distribution of CRTs. The Project Operator will have the option of whether or not their contracts with Aggregators are made available to the public. The contracts are required to include the following mandatory components:
    - Description of services the Aggregator will perform on behalf of the Project Operator with regards to Forest Project management.
    - Consequences of contract termination or failure by the Aggregator or the Project Operator.
    - Consequences and risks of inventory confidence fluctuations associated with variations in the numbers of participants in the aggregate, including a clear

[10] See http://www.climateactionreserve.org/open-an-account/.

statement how the Project Operator and the Aggregator will work together to manage the risks, such as reversals, associated with these fluctuations.
- The disposition of credits remaining in the Aggregator account in the event of contract termination or failure on behalf or the Aggregator and/or the Project Operator.
- An Exhibit including the Climate Action Reserve Forest Project Protocol Guidelines for Aggregation.

In the case where the Aggregator and the Project Operator are the same entity, the contract between the Aggregator and the Project Operator may take the form of a memo or memorandum of understanding (MOU) which covers the mandatory components required by the Reserve.

Once the Aggregate Entry form is submitted, Forest Projects must undergo an on-site verification before they will be allowed to join the aggregate. Forest Projects can only join an aggregate after they have undergone a site visit verification. This will ensure Forest Projects added to existing aggregates have quantified their CRTs per the FPP and have met the statistical requirements for estimates described in the FPP.

### 3.10.5 Leaving an Aggregate or Termination of Contract between Project Operator and Aggregator

To leave an aggregate, the Project Operator for a project is required to submit an "Aggregate Exit" form, which requires Reserve staff approval. This form includes:

- A Statement that the Project Operator intends to withdraw a project from a specific aggregate and Aggregator.
- If Project Operator intends to retain a standalone project, a statement that the Project Operator understands that they will be required to meet the standalone project inventory standards and that they will not be issued further credits until the Forest Project has undergone a site verification.
- In the case of termination of a contract between the Project Operator and Aggregator or if an Aggregator ceases to exist or is unable to provide aggregation services, the Project Operator may want to choose a replacement Aggregator. The participating Project Operator has 24 months to indicate the replacement Aggregator while account activities are suspended before requiring that Project Operator to become a standalone project.

The aggregate has 12 months from departure of a Forest Project, for any purpose, to either add a sufficient number of new participants to maintain the aggregate-wide confidence deduction. After 12 months, adjustments to the confidence deduction will be made which will apply to all of the remaining participants. The remaining individual Project Operators in the aggregate are responsible for the impacts that may occur due to the changes in confidence deductions caused by variations in the numbers of participants in an aggregate. This includes application of any confidence deductions and compensation for any reversals as specified in FPP (Section 7.3).

### 3.10.6 Accounts on the Reserve, Transfers, and Sales of CRTs

Each Project Operator with Forest Projects in an aggregate must have a separate account with the Reserve. For each participating Forest Project, the Project Operator must sign a PIA with the Reserve and meet all other requirements of described in this protocol.

Each Forest Project is required to contribute to the Reserve's Buffer Pool and compensate for reversals similar to standalone Forest Projects as described in Section 7 of the FPP. Each Forest Project is responsible to meet independently all reporting requirements described in Section 8 of the FPP. Many of these tasks, such as the transmission of annual documents may be managed by the Aggregator, if these are included in the scope of services negotiated between the Project Operator and the Aggregator and reflected in the contracts between the Project Operator and the Aggregator.

Aggregators must maintain a Reserve account to which CRTs can be transferred from the accounts of participating Project Operators, and from which CRTs can be transacted. The Aggregator will not need to take ownership of the CRTs from the Project Operator but all CRTs will need to be transferred and transacted out of the Aggregator's account. Transfers from individual Project Operator accounts to the aggregate account are not subject to Reserve CRT transfer fees. Project Operators can maintain control of the timing of any transfer to the Aggregator account. The timing, pricing and other details of the transfer of CRTs are up to the arrangement between the Project Operator and the Aggregator. The transfer to the Aggregator account maintains the statistical integrity of the aggregate over time. In addition, this process provides transparency to the buyer/transferee of the source of the CRTs as well as affording all members of the aggregate the advantages of marketing offset credits at volume.

All participating Forest Projects are identified in the Reserve's software as a part of a named aggregate along with the contact information of the Aggregator. The total credits issued to that aggregate's Forest Projects and current total credit holdings of that aggregate's Forest Projects are available by query in the Reserve's software. In addition, the software tracks the verification history of Forest Projects within an aggregate to ensure transparency and disclosure of compliance to verification standards over time.

## 3.11 Sustainable Harvesting and Natural Forest Management Practices

Forest Projects can create long-term climate benefits as well as provide other environmental benefits, including the sustaining of natural ecosystem processes. To be eligible under this protocol, Forest Projects must:

1. Employ sustainable long-term harvesting practices, both within their Project Area and on other forest landholdings controlled by the Project Operator and its Affiliate(s) within the project's Assessment Area(s). Forest landholdings are considered "controlled" by the Project Operator if the Project Operator owns the land in fee, or has been deeded timber rights on it.
2. Employ Natural Forest Management practices within the Project Area, as described below.

### 3.11.1 Sustainable Harvesting Practices

At the time a harvest plan has been submitted to a state or federal agency (if required) or commercial harvesting is initiated on any of the forest landholdings controlled by the Project Operator and its Affiliate(s) within the project's Assessment Area(s), the Project Operator and its Affiliate(s) must employ and demonstrate sustainable long-term harvesting practices on all of its forest landholdings within the project's Supersection(s), including the Project Area, using one of the following options:

1. Certification under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System certification programs. Regardless of the program, the terms of certification must require adherence to and verification of harvest levels which can be permanently sustained over time.
2. Adherence to a renewable long-term (50 years minimum) management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency (for federal lands only). This option is available to Forest Projects located entirely within qualifying Assessment Areas identified in the Assessment Area Resource File, a companion document to the FPP.
3. For Project Operators and their Affiliates that control less than 5,000 acres within an Assessment Area, the use of silvicultural practices (if harvesting occurs) that maintain canopy cover averaging at least 40 percent, as measured on any 20 acres of the Project Operator's and its Affiliate(s') landholdings within the project's Supersections(s), including the Project Area.[11] Exceptions may be granted by the Reserve where it can be demonstrated that the harvest openings are intended to restore plantations to forest conditions with greater species diversity.
4. Having a deeded conservation easement(s) with terms that ensure growth equals or exceeds harvest over time.

This requirement shall be met at all times during the project life and is assessed at each site visit verification. Failure to meet this requirement will result in all Reserve account activity being suspended until it is met.

Project Operators and their Affiliate(s) who acquire new forest landholdings within the project's Assessment Area(s) have up to five years to incorporate such acquisitions under their certification or management plan, whether or not such land is contiguous with the Project Area.

### 3.11.2 Natural Forest Management

All Forest Projects must promote and maintain a diversity of native species and utilize management practices that promote and maintain native forests comprised of multiple ages and mixed native species within the Project Area and at multiple landscape scales ("Natural Forest Management").

All Forest Projects are required to establish and/or maintain forest types that are native to the Project Area. For the purposes of this protocol, native forests are defined as those forests occurring naturally in an area, as neither a direct nor indirect consequence of human activity post-dating European settlement.

Required references by Assessment Area for the definition of native forests are provided in an Assessment Area Data File, a companion document to the FPP available on the Reserve's website. If a state/regional reference is unavailable or inadequate, the Project Operator must provide documentation from a state botanist or other qualified independent resource, recognized as expert by academic, private, and government organizations, indicating that the project employs native forests per the definition above. Where supported by scientific peer-reviewed research, the planting of native species outside of their current distribution is allowed as an adaptation strategy due to climate change. Such planting must be done in accordance with a state or federally approved adaptation plan, or a local plan that has gone through a transparent public review process. The Project Operator must obtain a written statement from the government agency in charge of forestry regulation in the state where the project is located

[11] Areas impacted by Significant Disturbance may be excluded from this test.

stipulating that the planting of native trees outside their current range is appropriate as an adaptation to climate change.

The following key requirements shall apply to all Forest Projects regardless of the silvicultural or regeneration methods that are used to manage or maintain the forest:

1. Forest Projects must maintain or increase standing live carbon stocks over the project life, as described in Section 3.11.3.

2. Forest Projects must show verified progress (verified at scheduled site visit verifications) towards native tree species composition and distribution consistent with the forest type and forest soils native to the Assessment Area.

3. Forest Projects must manage the distribution of habitat/age classes and structural elements to support functional habitat for locally native plant and wildlife species naturally occurring in the Project Area, as specified in Table 3.2 and Section 3.11.4 below.

Forest Projects must incorporate the criteria for Natural Forest Management for as long as monitoring and verification of the Forest Project are required by this protocol. Forest Projects that do not initially meet Natural Forest Management criteria but can demonstrate progress towards meeting these criteria at the times identified in Table 3.2 are eligible to register with the Reserve.

The evaluation worksheet provided in Table 3.2 shall be used to determine if the Forest Project meets the criteria for engaging in Natural Forest Management. The following evaluation must be completed and verified at a Forest Project's initial verification and at all subsequent verifications. Forest Project carbon stock inventories (requirements for which are found in the Quantification Guidance on the FPP webpage) should be used as the basis of these assessments where applicable.

**Table 3.2.** Evaluation Criteria to Test if a Forest Project Meets the Requirement for the Establishment and Maintenance of Native Species and Natural Forest Management

| Criteria | When Assessed | Results of Not Passing Criteria | Application Rules |
|---|---|---|---|
| **Native Species** | | | |
| Project consists of at least 95% native species based on the sum of carbon in the standing live pool. The assessment shall be conducted using estimates of stems per acre for Reforestation Projects and basal area per acre for Improved Forest Management and Avoided Conversion Projects. | Assessed at initial verification from inventory data. | Forest Project is not eligible unless demonstrated that management will achieve this goal over the project life. | Applies to all project types throughout the project life. |
| | Assessment during site visit verifications must demonstrate continuous progress toward goal. This criterion must be met within 50 years. | All of the Forest Project's Reserve account activity will be suspended until the criterion is met. | |
| **Composition of Native Species** | | | |
| **Improved Forest Management and Avoided Conversion Projects**<br><br>Where the Project Area naturally consists of a mixed species distribution, no single species' prevalence, measured as the | Species composition is assessed at initial verification from inventory data. | Project is not eligible, unless it is demonstrated that management activities will enable this goal to be achieved over the project life. | Applies to all project types throughout the project life.<br><br>Some project |

| Criteria | When Assessed | Results of Not Passing Criteria | Application Rules |
|---|---|---|---|
| percent of the basal area of all live trees in the Project Area, exceeds the percentage value of standing live carbon shown under the heading 'Composition of Native Species' in the Assessment Area Data File maintained on the Reserve's website. Where the Project Area does not naturally consist of a mixed species distribution, the Project Operator<br>**Reforestation**<br><br>To the extent seed is available, and/or physical site characteristics permit, Reforestation Projects that involve planting of seedlings must either plant a mixture of native species or describe a strategy to incorporate naturally regenerated trees over time such that no single species' prevalence, measured as the percent of all live tree stems in the Project Area, exceeds the percentage value shown under the heading 'Composition of Native Species' in the Assessment Area table in the Assessment Area Data File maintained on the Reserve's website. | Species composition is also assessed during the project at each site visit verification.<br><br>Project must show continuous progress toward criteria. These criteria must be met within 50 years, except in cases where a variance has been granted at the initial verification, a Significant Disturbance has impacted species diversity, or natural mortality takes a project out of compliance. | Unless a variance has been granted, all of the project's Reserve account activity will be suspended until the criterion is met. | sites may not be capable of meeting the requirement. In these cases, the Project Operator may submit a letter signed by the State Forester, or his/her representative, stating that the Project Area's species diversity is reflective of background natural species diversity, at scales found in pre-European settings, from this criterion prior to Registration. |
| **Distribution of Age Classes** | | | |
| On a watershed scale up to 10,000 acres (or the Project Area, whichever is smaller), all projects must maintain, or make progress toward maintaining, no more than 40 percent of their forested acres in ages less than 20 years. (Areas impacted by Significant Disturbance may be excluded from this test.) | Age classes (if even-age management is used) are assessed at project initiation and each site visit verification. | NA | Applies to all project types at first commercial harvest. |
| | Age classes are assessed during project at each site visit verification.<br><br>Project must show continuous progress toward criterion. This criterion must be met within 25 years. | All Reserve account activity will be suspended until the criterion is met. | |
| **Structural Elements(Standing and Lying Dead Wood)** | | | |
| Project Operators must ensure that dead wood is recruited and maintained in sufficient quantities, as described below.<br><br>**Option I**. Monitoring dead wood throughout Project Area.<br><br>Project Operators may maintain inventories of lying dead wood as part of their normal inventory processes, Where inventory measurements are used to demonstrate compliance with this requirement, monumented plots or line transects must be used so the plot data can be verified. Dead wood measurements must achieve a minimum statistical confidence of +/- 30% at 1 Standard Error.<br><br>The combination of standing dead and lying dead wood shall be retained at average per acre values at quantity levels | Assessed during project at each site visit verification. | All Reserve account activity will be suspended until the areas verified since the previous site-verification meet the requirement. | Applies to all project types throughout the project life. |

| Criteria | When Assessed | Results of Not Passing Criteria | Application Rules |
|---|---|---|---|
| identified in the Assessment Area data file. If dead material does not exist at the quantities identified in the Assessment Area data file, dead trees shall be recruited as described below for Option II.<br><br>**Option II**: Monitoring dead wood on harvested areas.<br><br>The assessment of sufficient lying and standing dead material shall be made in areas harvested since the last site verification.<br><br>**For portions of the Project Area that have been harvested under normal circumstances (not salvage harvested):**<br><br>The combination of standing dead and lying dead wood shall be retained at average per acre values at quantity levels identified in the Assessment Area data file within each harvested unit. If dead material does not exist at the required levels within the harvest units, live trees shall be retained and tagged with aluminum tags at three times the amount identified in the Assessment Area data file minus whatever quantity does exist within each harvest unit.<br><br>**For portions of the Project Area that have been salvage harvested:**<br><br>The combination of standing dead and lying dead wood shall be retained at a combined four tonnes per acre on average within each harvest unit.<br><br>Verification that the requirement has been met shall be conducted using the methodology for verification of dead material transects found on the Quantification Guidance on the FPP webpage. | | | |

* Reforestation Projects submitted prior to September 1, 2010 are exempt from this requirement for salvage harvesting that occurred prior to the project's start date.

### 3.11.3 Promotion of the Onsite Standing Live Carbon Stocks

In an effort to promote and maintain the environmental benefits of Forest Projects, the Reserve requires that the standing live carbon stocks within the Project Area be maintained and/or increased during the project life. Therefore, except as specified below, the Reserve will not issue CRTs for quantified GHG reductions and removals achieved by a Forest Project if the Forest Project's monitoring reports – over any ten-year consecutive period – indicate a decrease in the standing live carbon stocks.

Exceptions to this policy are allowed where reductions in standing live carbon stocks are important for maintaining and enhancing forest health, environmental co-benefits, or the long-term security of all carbon stocks; where reductions are due to non-harvest disturbances; or where reductions are required by law. Note that these exceptions in no way change or affect the

Reserve's policies and requirements related to compensating for reversals, as detailed in Section 7.3.

Forest Project standing live carbon stocks that have decreased over a ten-year period may continue to receive CRTs issued by the Reserve for verified GHG reductions and removals if, and only if, the decrease in standing live carbon stocks is due to one of the following causes:

1. The decrease is demonstrably necessary to substantially improve the Project Area's resistance to wildfire, insect, or disease risks. The Project Operator must document the risks and the actions that will be taken to reduce the risks. The techniques used to improve resistance must be supported by relevant published peer reviewed research.

2. The decrease is associated with a planned balancing of age classes (regeneration, sub-merchantable, and merchantable) and is detailed in a long term environmentally responsible management plan. The Project Operator must demonstrate, using documentation submitted to the Reserve at the time of the Forest Project's registration, that the balancing of age classes, resulting in a decrease in the standing live carbon stocks, was planned at the initiation of the Forest Project (Figure 3.1).

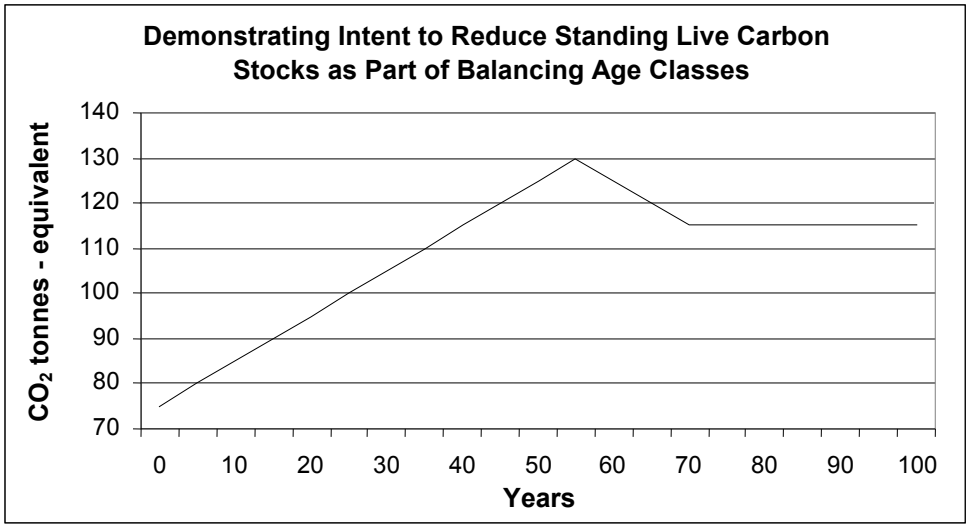



**Figure 3.1.** Example of Reducing Standing Live Carbon Stocks as Part of Balancing Age Classes

3. The decrease is part of normal silviculture cycles for forest ownerships less than 1,000 acres. Inventory fluctuations are a normal part of silvicultural activities. Periodic harvest may remove more biomass than the biomass growth over the past several years. At no time shall the Forest Project's inventory of carbon in the standing live carbon stocks fall below the Forest Project's baseline carbon stock estimates for the standing live carbon stocks, or 20 percent less than the Forest Project's standing live carbon stocks at the project's initiation, whichever is higher. Documentation submitted to the Reserve at the time the Forest Project is registered must indicate that fluctuations in the Forest Project's standing live carbon stocks are an anticipated silvicultural activity and that the overall trend will be for standing live carbon stocks to increase or stay the same over the life of the project (Figure 3.2).

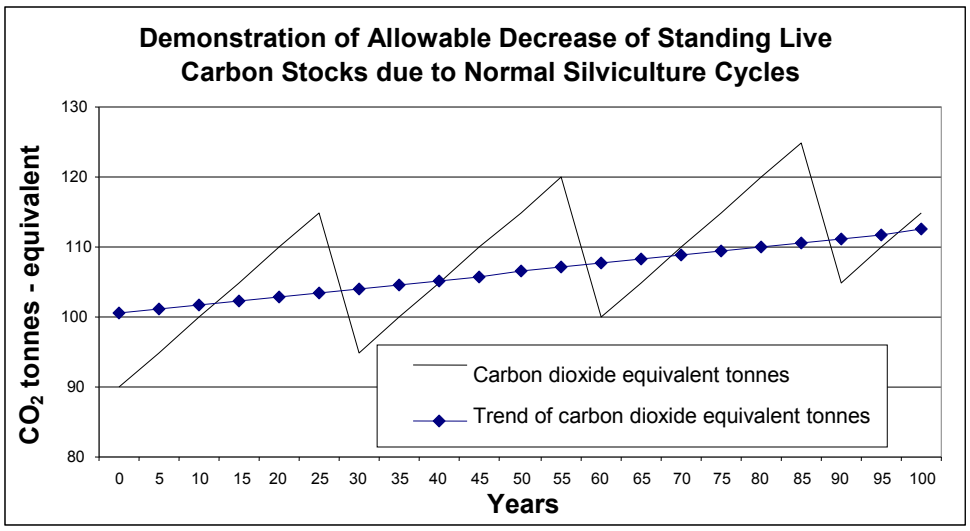



**Figure 3.2.** Example of Allowable Decrease of Standing Live Carbon Stocks due to Normal Silviculture Cycles

4. The decrease is part of a non-harvest disturbance, including wildfire, disease, flooding, wind-throw, insect infestation, landslides, or as otherwise approved by the Reserve.

### 3.11.4 Balancing Age and Habitat Classes

A variety of silvicultural practices may be employed in the Project Area during the course of a Forest Project though the protocol does not endorse any particular practice. To ensure environmental integrity, Forest Projects must meet a minimum set of standards in the use of any such practices.

For projects that employ even-aged management practices, harvesting must be limited to stands no greater than 40 acres. Stands adjacent to recently harvested stands must not be harvested using an even-aged harvest until the average age of the adjacent stand is at least five years old, or the average height in the adjacent stand is at least five feet. On a watershed scale up to 10,000 acres, all projects must maintain, or make progress toward maintaining, no more than 40 percent of their forested acres in ages less than 20 years. Areas impacted by a Significant Disturbance are exempt from this test until 20 years after reforestation of such areas.

The protocol does not override a landowner's obligation to abide by applicable laws and regulations, including any governing forest practice rules that may be more stringent. Regardless of the silvicultural practice employed, landowners must fulfill their commitment under the protocol to permanently maintain or increase onsite standing live carbon stocks (i.e. the carbon in live trees within the Project Area) as specified in Section 3.11.3.

# 4 Identifying the Project Area

The geographic boundaries defining the Project Area must be described in detail at the time a Forest Project is listed on the Reserve. The boundaries must be defined using a map, or maps that displays public and private roads, major watercourses (fourth order or greater), topography, towns, and public land survey townships, ranges, and sections or latitude and longitude. The maps should be of adequate resolution to clearly identify the required features. Reforestation Projects may submit a provisional project boundary that must be amended to the actual areas reforested within the provisional project boundary by the second site visit verification. After the second site visit verification the project boundary may no longer be amended.

A Geographical Information System file (GIS shapefile) must be submitted to the Reserve with the project. The shapefile must be converted to a KML file. The acres reported for the project must be based on the acres calculated from the shapefile. The Project Area can be contiguous or separated into tracts. The Project Area may also extend across multiple Assessment Areas within an Ecosection or Supersection (see Guidance for Determining Common Practice on the Assessment Area Data webpage), and across no more than two adjacent Ecosections or Supersections.

For Improved Forest Management Projects, the geographic boundaries may be defined such that non-forested areas, or areas not under forest management, are excluded from the Project Area.

For Reforestation Projects, the Project Area must be on land that has had less than ten percent tree canopy cover for a minimum of ten years, or that have been subject to a Significant Disturbance that resulted in at least 20 percent of the carbon stocks being emitted.

For Avoided Conversion Projects, the Project Area is defined through the required appraisal process. The Project Area must be determined following the guidance in Table 4.1 based on the type of anticipated conversion.

**Table 4.1.** Project Area Definition for Avoided Conversion Projects

| Conversion Type | Project Area Definition |
|---|---|
| Residential | The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in residential development. |
| Agricultural Conversion | The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in agricultural production. |
| Golf Course | The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' as a golf course. This is to include forested areas within 200 feet of fairways, greens, and buildings. |
| Commercial Buildings | The boundary of the parcel or parcels that have been appraised as having a 'higher and better use' in commercial buildings. This is to include forested areas with 200 feet of suitable building sites. |

# 5 GHG Assessment Boundary

The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs that must be accounted for in quantifying a Forest Project's GHG reductions and removals (Section 6). 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 mobile combustion GHG emissions. 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 GHG removals) or its "Secondary Effects" (i.e. unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the Forest Project).[12] 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 following the methods described in Section 6.

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

## 5.1 Reforestation Projects

**Table 5.1.** GHG Assessment Boundary – Reforestation Projects
All optional pools included in Forest Project must independently meet minimum confidence requirements for inclusion.

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| RF-1 | Standing live carbon (carbon in all portions of living trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Modeled based on initial field inventory measurements<br><br>**Project:** Measured by field measurements and updating forest carbon inventory | Increases in standing live carbon stocks are likely to be the largest Primary Effect of Reforestation Projects.<br><br>For baseline estimation purposes, pre-existing trees must be distinguished from planted trees. Since pre-existing and new trees are easy to distinguish for several decades after tree planting, pre-existing trees do not need to be inventoried until the Project Operator first seeks verification of GHG reductions and removals (subsequent to the project's initial site visit verification and registration). |
| RF-2 | Shrubs and herbaceous | Reservoir / Pool | $CO_2$ | Included for site | **Baseline:** Assumed to be static with start | Shrubs and herbaceous understory may constitute a significant portion of carbon |

[12] 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.

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | understory carbon | | | preparation activities. | date inventory estimates<br><br>**Project:** Estimated decrease at project initiation with site preparation and assumed static thereafter | affected by Reforestation Projects as part of site preparation. |
| RF-3 | Standing dead carbon (carbon in all portions of dead, standing trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Assumed to be static based on initial field inventory measurements<br><br>**Project:** Measured by updating forest carbon inventory | Reforestation Projects may significantly increase standing dead carbon stocks over time. The protocol requires recruitment and retention of dead material, including standing dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| RF-4 | Lying dead wood carbon | Reservoir / Pool | $CO_2$ | Included for site preparation activities. | **Baseline:** Assumed to be static with start date inventory estimates<br><br>**Project:** Estimated decrease at project initiation with site preparation and assumed static thereafter | Lying dead wood may constitute a significant amount of carbon affected by Reforestation Projects as part of site preparation<br><br>For Natural Forest Management criteria, the protocol requires recruitment and retention of dead material, including lying dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| RF-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir / Pool | $CO_2$ | Included for site preparation activities. | **Baseline:** Assumed to be static with start date inventory estimates<br><br>**Project:** Estimated decrease at project initiation with site preparation and assumed static thereafter | Litter and duff may constitute a significant amount of carbon affected by Reforestation Projects as part of site preparation. |
| RF-6 | Soil carbon | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Assumed to be static with start date inventory estimates<br><br>**Project:** Emissions from project activities estimated with standardized guidelines in the Soil Quantification Guidance on the FPP webpage | Soil carbon may constitute a significant portion of carbon affected by reforestation projects. All projects must use standardized guidance to account for potential soil carbon emissions associated with management activities. |
| RF-7 | Carbon in in-use forest products | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Estimated from modeled harvesting volumes<br><br>**Project:** Estimated from measured harvesting volumes | Included because many Reforestation Projects will significantly increase carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to |

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for $CO_2$ emissions from decomposition or disposal of wood products (see SSR RF-17). |
| RF-8 | Forest product carbon in landfills | Reservoir / Pool | $CO_2$ | Excluded when project harvesting exceeds baseline<br><br>Included when project harvesting is below baseline | **Baseline:** Estimated from modeled harvesting volumes<br><br>**Project:** Estimated from measured harvesting volumes | Because of significant uncertainties associated with forecasting the quantity of forest product carbon that will remain stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated. |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| RF-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included | **Baseline:** N/A<br><br>**Project:** Quantified based on measured carbon stock changes in included reservoirs as part of site preparation (see above) | Biological emissions from site preparation are not quantified separately but rather are captured by measuring changes in included carbon reservoirs (shrubs and herbaceous understory; soil carbon where applicable). Reforestation Projects are not eligible if harvesting of live trees (standing live carbon) has occurred within the Project Area within the last 10 years. |
| RF-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Included | **Baseline:** N/A<br><br>**Project:** Estimated using default emission factors | Mobile combustion $CO_2$ emissions from Reforestation Project site preparation activities can be significant relative to total GHG reductions/removals. In general, this protocol assumes that combustion emissions in the U.S. will be controlled under a regulatory cap-and-trade program in the near future, and can therefore be ignored in the context of Forest Project GHG accounting. Since these emissions are not currently capped, however, and because site preparation is a one-time event rather than an ongoing source of emissions, mobile combustion emissions are included in the GHG Assessment Boundary for this version of the Forest Project Protocol. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $N_2O$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| RF- | Mobile | Source | $CO_2$ | Excluded | **Baseline:** N/A | Mobile combustion $CO_2$ emissions from |

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| 11 | combustion emissions from ongoing project operation and maintenance | | | | **Project:** N/A | ongoing project operation and maintenance are unlikely to be significantly different from baseline levels, and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br>**Project:** N/A | $CH_4$ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br>**Project:** N/A | $N_2O$ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| RF-12 | Stationary combustion emissions from ongoing project operation and maintenance | Source | $CO_2$ | Excluded | **Baseline:** N/A<br>**Project:** 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 Project Operator 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. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br>**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<br>**Project:** N/A | $N_2O$ emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| RF-13 | Biological emissions from clearing of forestland outside the Project Area | Source | $CO_2$ | Included | **Baseline:** N/A<br>**Project:** Estimated using default land-use conversion factors for non-project land | Reforestation Projects on land currently 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 or physical response to the project activity. Emission associated with shifting land uses are estimated using default "leakage" factors from published sources. |
| RF-14 | Biological emissions/ removals from changes in | Source / Sink | $CO_2$ | Excluded | **Baseline:** N/A<br>**Project:** N/A | Reforestation Projects will tend to increase harvesting levels relative to the baseline, potentially causing other landowners to reduce harvesting in |

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | harvesting on forestland outside the Project Area | | | | | response to increased wood product supply. The reduction in harvesting may lead to increased carbon stocks on other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure their permanence.<br><br>Reforestation Projects are not expected to cause an increase in harvesting on other lands (except where clearing is involved for other land uses, per SSR RF-13), so this potential effect is also excluded from the GHG Assessment Boundary. |
| RF-15 | Combustion emissions from production, transportation, and disposal of forest products | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest products. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| RF-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |

| SSR | Description | Type | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |
| RF-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | **Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR RF-7) and landfills (SSR RF-8)<br><br>**Project:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR RF-7) and landfills (SSR RF-8) | $CO_2$ emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR RF-7 and Quantification Guidance on the FPP webpage. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**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. This protocol assumes that landfill $CH_4$ emissions will be largely controlled in the near future due to federal and/or state regulations. 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 landfills. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Decomposition of forest is not expected to be a significant source of $N_2O$ emissions. |

## 5.2 Improved Forest Management Projects

**Table 5.2.** GHG Assessment Boundary – Improved Forest Management Projects

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| IFM-1 | Standing live carbon (carbon in all portions of living trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Modeled based on initial field inventory measurements, regulatory environment, and financial feasibility<br><br>**Project:** Measured by field measurements and | Increases in standing live carbon stocks are likely to be the largest Primary Effect of Improved Forest Management Projects. |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | updating forest carbon inventory | |
| IFM-2 | Shrubs and herbaceous understory carbon | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Shrubs and herbaceous understory constitute a relatively small proportion of carbon stocks in an Improved Forest Management project. |
| IFM-3 | Standing dead carbon (carbon in all portions of dead, standing trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Assumed to be static based on initial field inventory measurements<br><br>**Project:** Measured by updating forest carbon inventory | Improved Forest Management Projects may significantly increase standing dead carbon stocks over time. The protocol requires recruitment and retention of dead material, including standing dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| IFM-4 | Lying dead wood carbon | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Lying dead wood is highly variable and it is therefore difficult to achieve accurate estimates. It also constitutes a minor portion of forest carbon. With required retention for Natural Forest Management (see below), it is a conservative programmatic measure not to include it.<br><br>For Natural Forest Management criteria, the protocol requires recruitment and retention of dead material, including lying dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| IFM-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals. It is a conservative programmatic measure not to include it. |
| IFM-6 | Soil carbon | Reservoir / Pool | $CO_2$ | Included for emissions estimates | **Baseline:** Assumed to be static with start date inventory estimates<br><br>**Project:** Emissions from project activities estimated with standardized guidelines in found in the Quantification Guidance on the FPP webpage | Soil carbon is not anticipated to change significantly as a result of most Improved Forest Management activities. However, all projects must use standardized guidance to account for potential soil carbon emissions associated with management activities. |
| IFM-7 | Carbon in in-use forest products | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Estimated from modeled harvesting volumes<br><br>**Project:** Estimated from measured harvesting volumes | Included because many Improved Forest Management Projects may significantly change carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for $CO_2$ emissions from decomposition or disposal |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | of wood products (see SSR IFM-17). |
| IFM-8 | Forest product carbon in landfills | Reservoir / Pool | $CO_2$ | Excluded when project harvesting exceeds baseline<br><br>Included when project harvesting is below baseline | **Baseline:** Estimated from modeled harvesting volumes<br><br>**Project:** Estimated from measured harvesting volumes | Because of significant uncertainties associated with forecasting the quantity of forest product carbon that will remain stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated. |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| IFM-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included | **Baseline:** N/A<br><br>**Project:** Quantified based on measured carbon stock changes in included reservoirs (SSR IFM-6, where applicable) | Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs (soil carbon, where applicable). For other carbon reservoirs, changes are unlikely to have a significant effect on total quantified GHG reductions/removals. |
| IFM-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Mobile combustion $CO_2$ emissions from site preparation are not expected to be significantly different from baseline levels for Improved Forest Management Projects. In addition, this protocol assumes that combustion emissions in the U.S. will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $N_2O$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| IFM-11 | Mobile combustion emissions from ongoing project operation and maintenance | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** 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. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant. |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $N_2O$ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| IFM-12 | Stationary combustion emissions from ongoing project operation and maintenance | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** 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 Project Operator 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. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $N_2O$ emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| IFM-13 | Biological emissions from clearing of forestland outside the Project Area | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Improved Forest Management Projects are not expected to cause significant shifts in alternative land uses that might lead to clearing of forestland. |
| IFM-14 | Biological emissions/ removals from changes in harvesting on forestland outside the Project Area | Source / Sink | $CO_2$ | Included / Excluded | **Baseline:** N/A<br><br>**Project:** Estimated using a default 20% "leakage" factor applied to the difference in harvest volume relative to baseline | Improved Forest Management Projects may either increase or decrease harvesting relative to baseline levels. If harvesting is reduced in the Project Area, harvesting on other lands may increase to compensate for the lost production. This "leakage" effect is included in the GHG Assessment Boundary.<br><br>If harvesting is increased in the Project Area, harvesting on other lands may decrease in response to the increased production. The reduction in harvesting may lead to increased carbon stocks on other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure their permanence. |
| IFM-15 | Combustion emissions from production, transportation, | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | and disposal of forest products | | | | | Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest products. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| IFM-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |
| IFM-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | **Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR IFM-7) and landfills (SSR IFM-8)<br><br>**Project:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR IFM-7) and landfills (SSR IFM-8) | $CO_2$ emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR IFM-7 and Quantification Guidance on the FPP webpage. |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**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. This protocol assumes that landfill $CH_4$ emissions will be largely controlled in the near future due to federal and/or state regulations. 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 landfills. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Decomposition of forest is not expected to be a significant source of $N_2O$ emissions. |

## 5.3 Avoided Conversion Projects

**Table 5.3.** GHG Assessment Boundary – Avoided Conversion Projects

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| AC-1 | Standing live carbon (carbon in all portions of living trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates<br><br>**Project:** Measured by field measurements and updating forest carbon inventory | Preservation and/or increases of standing live carbon stocks and/or soil carbon stocks relative to baseline levels are likely to be a large Primary Effect of Avoided Conversion Projects. |
| AC-2 | Shrubs and herbaceous understory carbon | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in this reservoir/reservoir are unlikely to have a significant effect on total quantified GHG reductions/removals. Additionally, it is a conservative programmatic measure to exclude shrubs and herbaceous understory carbon. |
| AC-3 | Standing dead carbon (carbon in all portions of dead, standing trees) | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Assumed to be static based on initial field inventory measurements<br><br>**Project:** Measured by updating forest carbon inventory | Avoided Conversion Projects may significantly increase standing dead carbon stocks over time. The protocol requires recruitment and retention of dead material, including standing dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| AC-4 | Lying dead wood carbon | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Exclusion of lying dead wood is programmatically conservative for accounting of total quantified GHG reductions/removals, since project |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | activities most likely will lead to increases in lying dead wood carbon. Lying dead wood is highly variable and is difficult to measure accurately, and therefore challenging to achieve confidence with estimates<br><br>For Natural Forest Management criteria, the protocol requires recruitment and retention of dead material, including lying dead wood as a structural element. Minimum volume thresholds are stated to meet Natural Forest Management criteria. (See Section 3.11.2). |
| AC-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir / Pool | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Exclusion of litter and duff carbon is programmatically conservative for accounting of total quantified GHG reductions/removals, since project activities most likely will lead to increases in litter and duff carbon. Litter and duff is highly variable, difficult to measure accurately, and therefore challenging to achieve confidence with estimates. |
| AC-6 | Soil carbon | Reservoir / Pool | $CO_2$ | Optional for reporting project benefits.<br><br>Included for reporting project emissions. | **Baseline:** When included, assumed to have emissions and emission rates according to soil order and baseline conversion activity<br><br>**Project:** Emissions calculated using standardized guidance in the Soil Quantification Guidance on the FPP webpage. Project Operators may opt to quantify net removals or avoided emissions by updating forest soil carbon inventory | Soil carbon is likely a large primary effect of an Avoided Conversion Project. It is conservative to exclude the conversion effect on soil from the project accounting, which is why it is optional. All projects must use standardized guidance to account for potential soil carbon emissions associated with project management activities.<br><br>If Project Operators choose to quantify net removals or avoided emissions from soil carbon, they may do so by undertaking and updating a soil carbon inventory. |
| AC-7 | Carbon in in-use forest products | Reservoir / Pool | $CO_2$ | Included | **Baseline:** Estimated from modeled harvesting volumes<br><br>**Project:** Estimated from measured harvesting volumes | Included because many Avoided Conversion Projects may significantly change carbon storage in in-use forest products relative to baseline levels. Treated as a "source/sink" because forest product carbon is quantified according to the change in harvesting volumes, relative to baseline levels, in each year. Of this change (increase or decrease), only the average amount of carbon expected to remain stored for 100 years is included in the final quantification of annual net GHG removals/emissions. This approach accounts for $CO_2$ emissions from decomposition or disposal of wood products (see SSR AC-17). |
| AC-8 | Forest product carbon in landfills | Reservoir / Pool | $CO_2$ | Excluded when project | **Baseline:** Estimated from modeled harvesting volumes | Because of significant uncertainties associated with forecasting the quantity of forest product carbon that will remain |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | harvesting exceeds baseline<br><br>Included when project harvesting is below baseline | **Project:** Estimated from measured harvesting volumes | stored in landfills, landfill carbon is excluded from quantification in years when project harvesting volumes exceed baseline volumes. Landfill carbon is included, however, in years when project harvesting volumes are below baseline levels. This case-dependent exclusion or inclusion is necessary to ensure that total GHG reductions and removals caused by the Forest Project are not overestimated. |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | | |
| AC-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included | **Baseline:** N/A<br><br>**Project:** Quantified based on measured carbon stock changes in included reservoirs (SSR AC-6, where applicable) | Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs (soil carbon, where applicable). For other carbon reservoirs, changes are unlikely to have a significant effect on total quantified GHG reductions/removals. |
| AC-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Mobile combustion $CO_2$ emissions from site preparation (including land-use conversion activities) are likely to be higher in the baseline than under project. These emissions are therefore excluded from the GHG Assessment Boundary in order to be conservative. In addition, this protocol assumes that combustion emissions in the United States will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Differences in $CH_4$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Differences in $N_2O$ emissions from mobile combustion associated with site preparation activities are not considered significant. |
| AC-11 | Mobile combustion emissions from ongoing project operation and maintenance | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** 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. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A | Changes in $N_2O$ emissions from mobile |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | **Project:** N/A | combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| AC-12 | Stationary combustion emissions from ongoing project operation and maintenance | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** 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 Project Operator facilities, or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from (or will be lower than) baseline levels and are therefore not included in the GHG Assessment Boundary. In addition, this protocol assumes that such emissions will be controlled under a regulatory cap-and-trade program in the near future, meaning that changes in activity due to the Forest Project will have no effect on total net emissions. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $CH_4$ emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in $N_2O$ emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant. |
| AC-13 | Biological emissions from clearing of forestland outside the Project Area | Source | $CO_2$ | Included | **Baseline:** N/A<br><br>**Project:** Estimated using default forestland conversion factors | Avoided Conversion Projects may cause land-use pressures to shift to other forestlands, causing biological emissions that partially negate the benefits of the project. |
| AC-14 | Biological emissions/ removals from changes in harvesting on forestland outside the Project Area | Source / Sink | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Over time, Avoided Conversion Projects will tend to 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 other lands. Carbon stock increases on other lands are excluded from the GHG Assessment Boundary, however, because it is not possible to ensure their permanence.<br><br>Avoided Conversion Projects are not expected to cause an increase in harvesting on other lands over the long run (except where clearing is involved for other land uses, per SSR AC-13), so this potential effect is also excluded from the GHG Assessment Boundary. |
| AC-15 | Combustion emissions from production, | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | This protocol assumes that combustion emissions will be controlled under a regulatory cap-and-trade program in the |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | transportation, and disposal of forest products | | | | | near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of forest products. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of forest products are not considered significant. |
| AC-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Changes in forest-product production may cause consumers of these products to increase or decrease their consumption of substitute materials (such as alternative building materials, including cement or steel). In many cases, alternative materials will have higher combustion GHG emissions associated with their production, transportation, and/or disposal than wood products. This protocol assumes, however, that combustion emissions will be controlled under a regulatory cap-and-trade program in the near future. Thus, for most of a Forest Project's duration, changes in activity due to the project will have no effect on total net emissions due to production, transportation, and disposal of alternative materials. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $CH_4$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Combustion-related $N_2O$ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant. |
| AC-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | **Baseline:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR AC-7) and landfills (SSR AC-8)<br><br>**Project:** Quantified as a component of calculating carbon stored for 100 years in wood products (SSR AC-7) and landfills (SSR AC-8) | $CO_2$ emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR AC-7 and Quantification Guidance on the FPP webpage. |

| SSR | Description | Type* | Gas | Included or Excluded | Quantification Method | Justification/Explanation |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | $CH_4$ | Excluded | **Baseline:** N/A<br><br>**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. This protocol assumes that landfill $CH_4$ emissions will be largely controlled in the near future due to federal and/or state regulations. 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 landfills. These emissions are therefore excluded from the GHG Assessment Boundary. |
| | | | $N_2O$ | Excluded | **Baseline:** N/A<br><br>**Project:** N/A | Decomposition of forest is not expected to be a significant source of $N_2O$ emissions. |

# 6 Quantifying Net GHG Reductions and Removals

This section provides requirements and guidance for quantifying a Forest Project's net GHG reductions and removals. The Reserve will issue Climate Reserve Tonnes (CRTs) to a Forest Project upon confirmation by an ISO-accredited and Reserve-approved verification body that the Forest Project's GHG reductions and removals have been quantified following the applicable requirements of this section (see Section 9 for verification requirements).

For each type of Forest Project, quantification proceeds in seven steps:

1. **Estimating baseline onsite carbon stocks.** The baseline is an estimate of what would have occurred in the absence of a Forest Project. To establish baseline onsite carbon stocks, the Project Operator must model 100 years of carbon stock changes in each of the Forest Project's required and selected optional onsite carbon pools (identified in Sections 5.1 to 5.3). Modeling must be based on inventoried carbon stocks at the time of the Forest Project's initiation (or when first inventoried as is allowed for Reforestation Projects), following the applicable requirements in this section. Onsite carbon stocks are inventoried following the requirements described in the Quantification Guidance on the FPP webpage. Modeling of onsite carbon stocks over time must be conducted following the requirements in this section and the guidance in the Quantification Guidance. Baseline onsite carbon stocks are estimated over a Forest Project's entire crediting period (100 years) at the time of the project's initiation and are not modified thereafter, except for reconciliation of project baselines to changes in inventory estimates associated with inventory methodology updates.

2. **Estimating baseline carbon in harvested wood products.** In conjunction with modeling baseline onsite carbon stocks, the Project Operator must forecast any harvesting that would have occurred in the baseline and convert this to an average annual harvesting volume. From this, the Project Operator must determine the amount of carbon that would have been transferred each year (on average) to long-term storage in wood products. Baseline harvesting is forecasted following the guidance in this section and carbon stored in wood products must be calculated following the requirements in the Quantification Guidance.

3. **Determining actual onsite carbon stocks.** Each year, the Project Operator must determine the Forest Projects' actual onsite carbon stocks. This must be done by updating the Forest Project's forest carbon inventory for the current year, following the guidance in this section and in the Quantification Guidance. The estimate of actual onsite carbon stocks must be adjusted by an appropriate confidence deduction, as described in the Quantification Guidance.

4. **Determining actual carbon in harvested wood products.** Each year, the Project Operator must report any harvesting in the Project Area and from this determine the amount of carbon transferred to long-term storage in wood products. Carbon stored in wood products must be calculated following the requirements available in the Quantification Guidance.

5. **Calculating the project's Primary Effect.** Each year, the Project Operator must quantify the actual change in GHG emissions or removals associated with the Forest

Project's intended ("Primary") effect, as defined in Section 5. 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[13]
b. Subtracting from (a) the difference between baseline onsite carbon stocks for the current year and baseline onsite carbon stocks for the prior year[14]
c. Adding to (b) the calculated difference between actual and baseline carbon in harvested wood products for the current year (see Equation 6.1)

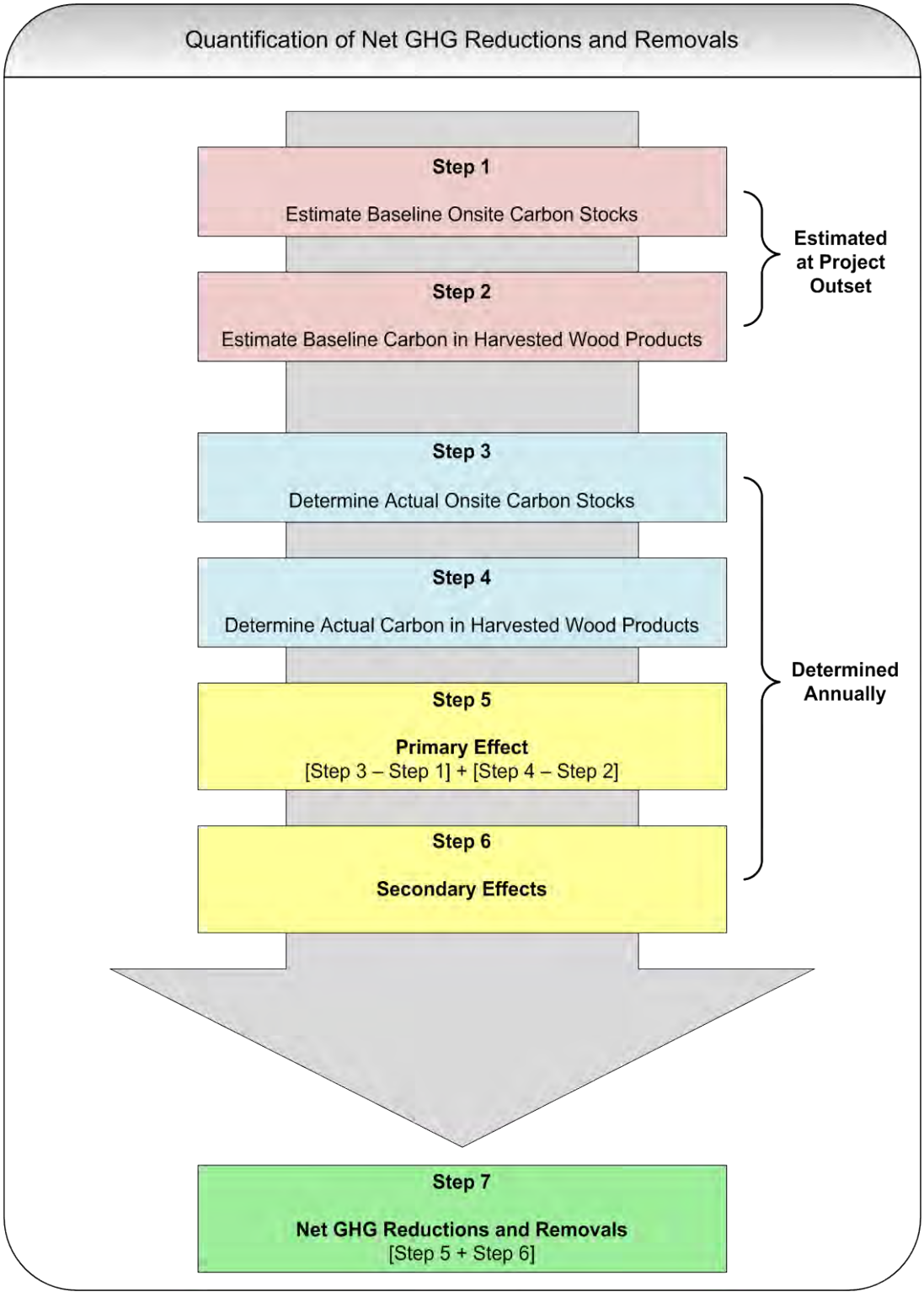
6. **Quantifying the project's Secondary Effects.** Each year, the Project Operator must quantify the actual change in GHG emissions or removals associated with the Forest Project's unintended ("Secondary") effects, as defined in Section 5. Requirements and guidance for quantifying Secondary Effects are provided below for each type of Forest Project. Secondary Effects will almost always be negative (i.e. they will reflect an increase in GHG emissions caused by the project).

7. **Calculating total net GHG reductions and removals.** For each year, total net GHG reductions and removals are calculated by summing a Forest Project's Primary and Secondary Effects. If the result is positive, then the Forest Project has generated GHG reductions and/or removals in the current year. If the result is negative, this may indicate a reversal has occurred (see Section 7).[15]

Requirements and guidance for how to perform quantification steps 1 to 4 for each Forest Project type are presented in the remainder of this section.

The required formula for quantifying annual net GHG reductions and removals is presented in Equation 6.1. Net GHG reductions and removals must be quantified and reported in units of carbon dioxide-equivalent ($CO_2e$) metric tons.

[13] 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.
[14] See footnote 13.
[15] A reversal occurs only if: (1) total net GHG reductions and removals for the year are negative; and (2) CRTs have previously been issued to the Forest Project. If calculated GHG reductions and removals are negative and no CRTs have been issued to the project since its start date, then the result should be treated as a "negative carryover" to GHG reduction calculations in subsequent years (variable $N_{y-1}$ in Equation 6.1). This may happen, for example, because the confidence deduction applied to actual onsite carbon stocks can result in actual values being less than baseline values in a Forest Project's initial years.


Quantification of Net GHG Reductions and Removals
Step 1
Estimate Baseline Onsite Carbon Stocks
Step 2
Estimate Baseline Carbon in Harvested Wood Products
Estimated at Project Outset
Step 3
Determine Actual Onsite Carbon Stocks
Step 4
Determine Actual Carbon in Harvested Wood Products
Step 5
Primary Effect
[Step 3 – Step 1] + [Step 4 – Step 2]
Step 6
Secondary Effects
Determined Annually
Step 7
Net GHG Reductions and Removals
[Step 5 + Step 6]

**Equation 6.1.** Annual Net GHG Reductions and Removals

$$\boldsymbol{QR_y = \left[(\Delta AC_{onsite} - \Delta BC_{onsite}) + \left(AC_{wp,y} - BC_{wp,y}\right) \times 80\% + SE_y\right] + N_{y-1}}$$

| *Where,* | | | Units |
|---|---|---|---|
| $QR_y$ | = | Quantified GHG reductions and removals for year y | $tCO_2e$ |
| $AC_{wp,\,y}$ | = | Actual carbon in wood products produced in year y that is projected to remain stored for at least 100 years (i.e. $WP_{total,\,y}$ derived for actual harvest volumes following the guidance in the Quantification Guidance | $tCO_2e$ |
| $BC_{wp,y}$ | = | Annual baseline carbon in wood products that would have remained stored for at least 100 years (i.e. $WP_{total,\,y}$ derived for baseline harvest volumes following the guidance in the Quantification Guidance | $tCO_2e$ |
| $SE_y$ | = | Secondary Effect GHG emissions caused by the project activity in year y | $tCO_2e$ |
| $N_{y-1}$ | = | Any negative carryover from the prior year (occurs when total quantified GHG reductions are negative prior to the issuance of any CRTs for the project– see footnote 15, p. 42) | $tCO_2e$ |

And,

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

*Where,*

| | | | |
|---|---|---|---|
| $AC_{onsite,\,y}$ | = | Actual onsite carbon as inventoried for year y (y may be less than a year for the first reporting period following the start date) | $tCO_2e$ |
| $AC_{onsite,\,y-1}$ | = | Actual onsite carbon as inventoried for year y-1 | $tCO_2e$ |
| $CD_y$ | = | Appropriate confidence deduction for year y, as determined following the Quantification Guidance | % |
| $CD_{y-1}$ | = | Appropriate confidence deduction for year y-1, as determined following the Quantification Guidance | % |

And,

$$\boldsymbol{\Delta BC_{onsite} = \left(BC_{onsite,y}\right) - \left(BC_{onsite,y-1}\right)}$$

*Where,*

| | | | |
|---|---|---|---|
| $BC_{onsite,\,y}$ | = | Baseline onsite carbon as estimated for year y (y may be less than a year for the first reporting period following the start date) | $tCO_2e$ |
| $BC_{onsite,\,y-1}$ | = | Baseline onsite carbon as estimated for year y-1 | $tCO_2e$ |

Note: The net change in carbon in harvested wood products, ($AC_{wp,\,y} - BC_{wp,\,y}$), is multiplied by 80 percent in Equation 6.1 to reflect market responses to changes in wood-product production. The general assumption in this protocol is that for every tonne of reduced harvesting caused by a Forest Project, the market will compensate with an increase in harvesting of 0.2 tonnes on other lands (see Section 6.2.6).[16] Since wood product production is directly related to harvesting levels, the net change in wood products caused by a Forest Project is subject to this same market dynamic. Thus, any one tonne increase/decrease in wood product production by a Forest Project will result in only a 0.8 tonne increase/decrease overall, because other landowners will decrease/increase production by 0.2 tonnes in response.

[16] For conservativeness and ease of accounting, these wood-product market "leakage" effects are ignored for Reforestation Projects and Avoided Conversion Projects, since overall these projects will tend to result in increased harvesting relative to the baseline. Market leakage effects are accounted for under Improved Forest Management Projects, however, as described in Section 6.2.6.

## 6.1 Reforestation Projects

### 6.1.1 Estimating Baseline Onsite Carbon Stocks

To estimate baseline carbon stocks for a Reforestation Project, the Project Operator must:

1. Provide a qualitative characterization of the likely vegetative conditions and activities that would have occurred without the project, taking into consideration any laws, statutes, regulations, or other legal mandates that would encourage or require reforestation on the Project Area. The qualitative assessment shall include an assessment of the commercial value of trees within the Project Area over the next 30 years. The qualitative assessment must be used as the basis for modeling baseline carbon stocks (step 3).

2. Inventory carbon stocks affected by site preparation prior to any site preparation activities, following the Quantification Guidance for sampling carbon pools affected by site preparation for Reforestation Projects.

   For carbon stocks not affected by site preparation, the inventory may be deferred, as described below.

3. Perform a computer simulation, once an inventory is obtained, that models the carbon stocks (from required and any selected optional pools) for 100 years following the project's start date, based on the qualitative characterization of what would have occurred without the project. The Project Operator must follow the requirements and guidance for modeling contained in the Quantification Guidance, incorporating any conditions and constraints specified in the qualitative characterization of the baseline (step 1, above). The computer simulation must model the expected growth in carbon stocks associated with pre-existing trees in the Project Area (i.e. those not planted as part of the Forest Project).

**Deferral of Initial Inventory for Carbon Stocks Not Affected by Site Preparation**

The inventory of carbon stocks that are not affected by site preparation may be deferred until a Reforestation Project's second site visit verification. By the second site visit verification, the Project Operator must provide an estimated inventory of all required carbon stocks by:

1. Assuming standing dead carbon stocks at the time of the Forest Project's start date were equal to the standing dead carbon stocks measured and verified at the second site visit verification.

2. Using an approved growth model or a stand table projection methodology, as described in the Quantification Guidance, to derive an estimate of standing live carbon stocks in pre-existing trees (i.e. those not planted as part of the Forest Project) at the time of the Forest Project's start date. The Project Operator must demonstrate that applying the approved growth model or stand table projection to the estimated tree records representing the start date condition produces a result within five percent of current inventory data for pre-existing trees.

If the inventory of these carbon pools is deferred, the timing of the second site visit verification is at the discretion of the Project Operator (it may be deferred for more than six years). Reforestation Projects for which an initial inventory is deferred are not eligible to receive CRTs

until after the second site visit verification where the start date inventory and the current inventory as of the second site visit verification are verified.

### 6.1.2 Estimating Baseline Carbon in Harvested Wood Products

If harvesting of the pre-existing trees would be expected to occur in the baseline, the following steps must be performed:

1. Use a model (see the Quantification Guidance) to determine the *average* amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year of the baseline over 100 years. The result will be a uniform estimate of harvested carbon in each year of the baseline. This estimate is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.

2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.1.3 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Reforestation Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.

2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in the Quantification Guidance. Guidance for projecting forest inventory plot data using models is also provided in the Quantification Guidance.

3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.

4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in the Quantification Guidance.

### 6.1.4 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.1.3).

2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.1.5 Quantifying Secondary Effects

For Reforestation Projects, significant Secondary Effects can arise from two sources:

1. Combustion emissions associated with machinery use in site preparation.

2. The shifting of cropland or grazing activities to forestland outside the Project Area (which may be both a market and/or physical response to the project activity), which is accounted for over the life of the project.

To quantify combustion emissions associated with site preparation, Project Operators must use the appropriate standard emission factor from Table 6.1 corresponding to the level of brush cover associated with the site preparation area, multiplied by the number of acres treated (Equation 6.2).

Mobile combustion emissions must be added to Secondary Effect emissions ($SE_y$ in Equation 6.1) in the first year of a project. If this results in a negative amount for total net quantified GHG reductions and removals in year one ($QR_1$), the negative amount must be carried over into future years ($N_{y-1}$ in Equation 6.1) until sufficient GHG reductions and removals are accrued to achieve a positive balance. Negative GHG reductions and removals due to site preparation emissions are *not* considered a reversal (Section 7.1).

**Equation 6.2.** Combustion Emissions Associated with Site Preparation

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

| *Where,* | | | Units |
|---|---|---|---|
| $MC_y$ | = | Secondary Effect emissions due to mobile combustion from site preparation | $tCO_2e$ |
| $EF_{mc}$ | = | Mobile combustion emission factor from Table 6.1 | $tCO_2e$ |
| PA | = | Size of the site preparation area | acres |

**Table 6.1.** Mobile Combustion Emissions for Reforestation Projects

| Site Prep - Reforestation Projects | | |
|---|---|---|
| Emissions Associated with Mobile Combustion<br>Average Metric Tons $CO_2$ per Acre | | |
| **Light** | **Medium** | **Heavy** |
| 25% Brush Cover | 50% Dense Brush Cover | > 50% Brush Cover, stump removal |
| **0.090** | **0.202** | **0.429** |

To quantify emissions from the shifting of cropland and grazing activities each year, Project Operators must determine the appropriate "leakage" risk percentage for the project following the decision tree in Figure 6.1. The leakage risk percentage must only be determined once, at the outset of the project. Each year, this percentage must be applied to the net increase in onsite carbon stocks to determine the annual Secondary Effects due to shifting of cropland or grazing activities (Equation 6.3).

**Equation 6.3.** Emissions from Shifting Cropland and Grazing Activities

$$AS_y = (-1) \times L \times (\Delta AC_{onsite} - \Delta BC_{onsite})$$

| *Where,* | | | Units |
|---|---|---|---|
| $AS_y$ | = | Secondary Effect emissions due to shifting of cropland or grazing activities | $tCO_2e$ |
| L | = | Leakage risk percentage, as determined from Figure 6.1 | % |
| $\Delta AC_{onsite}$ | = | Annual difference in actual onsite carbon as defined in Equation 6.1 | $tCO_2e$ |
| $\Delta BC_{onsite}$ | = | Annual difference in baseline onsite carbon as defined in Equation 6.1 | $tCO_2e$ |

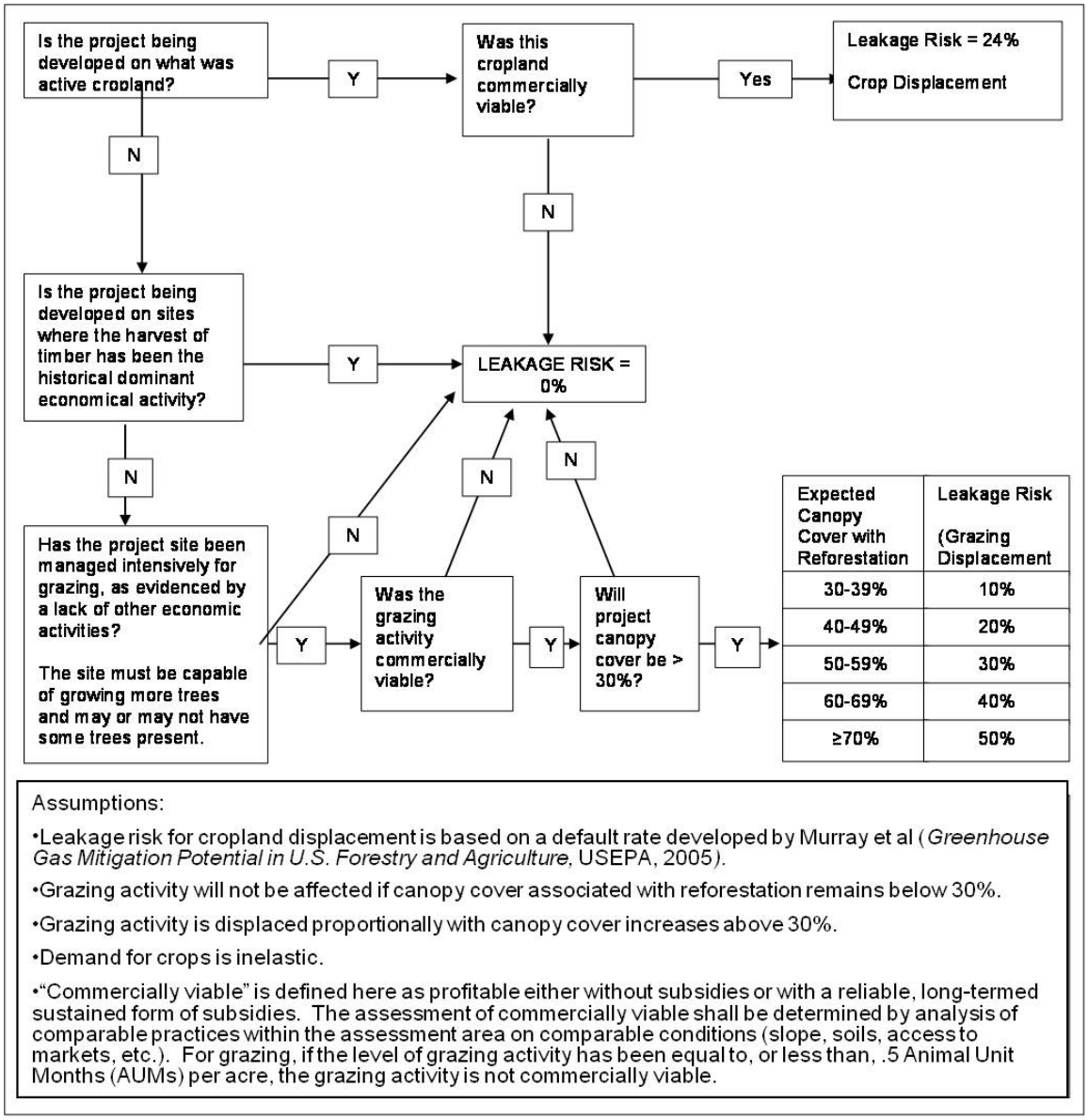



**Figure 6.1.** Activity Shifting ("Leakage") Risk Assessment for Reforestation Projects

Total Secondary Effect emissions for Reforestation Projects are calculated as follows (Equation 6.4). The value for Secondary Effect emissions will always be negative or zero.

**Equation 6.4.** Total Secondary Effect Emissions

$$SE_y = (AS_y + MC_y) \text{ or 0, whichever is lower}$$

*Where,*

| | | | Units |
|---|---|---|---|
| $SE_y$ | = | Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1) | $tCO_2e$ |
| $AS_y$ | = | Secondary Effect emissions due to shifting of cropland or grazing activities | $tCO_2e$ |
| $MC_y$ | = | Secondary Effect emissions due to mobile combustion from site preparation | $tCO_2e$ |

## 6.2 Improved Forest Management Projects

Improved Forest Management Projects that take place on private land – or on land that is transferred to public ownership at the time the project is initiated – must estimate baseline onsite carbon stocks following the requirements and procedures in Section 6.2.1. Improved Forest Management Projects that take place on land that was publicly owned prior to the project start date must estimate baseline onsite carbon stocks following the requirements and procedures in Section 6.2.2. Requirements for determining baseline carbon in harvested wood products, determining actual onsite carbon stocks, determining actual carbon in harvested wood products, and quantifying Secondary Effects are the same for all Improved Forest Management Projects.

### 6.2.1 Estimating Baseline Onsite Carbon Stocks – Private Lands

The baseline approach for Improved Forest Management Projects on private lands applies a standardized set of assumptions to project-specific conditions.
The following steps must be followed to estimate baseline carbon stocks:

1. Determine the inventories of above-ground standing live carbon stocks, below-ground standing live carbon stocks, and above and below-ground standing dead carbon stocks for the Project Area.
2. Model a 100-year growth and harvest regime reflecting legal and financial constraints. The result is a *preliminary unadjusted baseline* for carbon stocks that reasonably reflects the harvesting opportunities present within the Project Area.
3. Standardize the *preliminary unadjusted baseline* for above-ground standing live carbon stocks by averaging the annual values or, if legal constraints require stocks to increase over time, constructing an upward sloping straight line to the apex of the legal constraints and averaging annual values thereafter. Baseline carbon stocks for other carbon pools must be similarly standardized. This results in the *standardized unadjusted baseline* for reported carbon stocks.
4. Apply performance standard criteria to adjust the above-ground standing live portion of the *standardized unadjusted baseline*. The result is a *standardized adjusted baseline* for above-ground standing live carbon stocks.
5. Proportionally adjust other reported carbon stocks to match the *standardized adjusted baseline* for above-ground standing live carbon stocks.
6. Combine the results of Step 4 and Step 5 to produce the *final baseline* for all onsite carbon stocks.

*For all calculations in this section, all values for "carbon stocks" should be expressed in metric tonnes of $CO_2$-equivalent.*

**Step 1 – Inventory Carbon Stocks within the Project Area**

The start date inventory of standing live above ground carbon stocks, separated into above-ground and below-ground portions, and the start date inventory of standing dead carbon stocks, with above and below ground portions combined must be determined following the Reserve's Quantification Guidance.

In the formulas throughout this section, initial carbon stocks are denoted by the variable $PUB_0$ (i.e., the *preliminary unadjusted baseline* at time zero).

**Step 2 – Model Growth and Harvesting Over 100 Years**

The *preliminary unadjusted baseline* for onsite carbon stocks must be estimated through a modeling exercise. The modeling exercise must use the inventories of the carbon from Step 1 as a starting point for modeling. The *preliminary unadjusted baseline* will consist of each of the following carbon pools that are maintained separately during this stage of baseline development:

- Above-ground standing live.
- Below ground standing live.
- Standing dead (above and below-ground).
- Harvested above and below-ground standing live.
- Bole portion of harvested above and below-ground standing live.

To determine the *preliminary unadjusted baseline,* model the initial inventory of *above-ground* standing live carbon stocks through a series of growth and harvesting scenarios over a 100-year timeframe. Modeling must be conducted using an approved growth model, as identified in the Modeling Carbon Stocks section of the Quantification Guidance. Modeling of the growth and harvesting scenarios must reflect all legal requirements that constrain the ability to harvest carbon stocks. In addition, harvesting assumptions must reflect realistic financial constraints. .

Standing dead carbon stocks shall be assumed to remain static throughout the modeling process. Exceptions may be provided, at the Reserve's discretion, if compelling justification can be provided that standing dead carbon stocks are likely to fluctuate substantially as part of the project's baseline.

**Modeling Legal Constraints**

All legal constraints that affect the ability to manage carbon stocks must be included in the model design. The *preliminary unadjusted baseline* must represent a growth and harvesting regime that fulfills all legal requirements. Voluntary agreements that can be rescinded, such as rental contracts and forest certifications, are not legal constraints. Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) that are in place more than one year prior to the project's start date shall be modeled as legal constraints. HCPs and SHAs that are approved after the date one year prior to the project's start date are not considered legal constraints for the purpose of baseline modeling and may be disregarded.

Legal constraints include all laws, regulations, and legally-binding commitments applicable to the Project Area at the time of the project's initiation that could affect carbon stocks. Legal constraints include:

1. Federal, state/provincial, or local government regulations that are required and might reasonably be anticipated to influence carbon stocking over time including, but not limited to:
    a. Zones with harvest restrictions (e.g. buffers, streamside protection zones, wildlife protection zones)
    b. Harvest adjacency restrictions
    c. Minimum stocking standards
2. Forest practice rules, or applicable Best Management Practices established by federal, state, provincial or local government that relate to forest management.
3. Other legally binding requirements affecting carbon stocks including, but not limited to, covenants, conditions and restrictions, and other title restrictions in place prior to or at the time of project initiation, including pre-existing conservation easements, HCPs, SHAs, and deed restrictions, excepting an encumbrance that was put in place and/or recorded less than one year prior to the project start date, as defined in Section 3.6.

For Forest Projects located in California, the *preliminary unadjusted baseline* must be modeled to reflect all silvicultural treatments associated with timber harvest plans (THPs) active within the Project Area at the time of the project's initiation. All legally enforceable silvicultural and operational provisions of a THP – including those operational provisions designed to meet California Forest Practice Rules requirements for achieving Maximum Sustained Production of High Quality Wood Products [14 CCR 913.11 (933.11, 953.11)] – are considered legal constraints and must be reflected in baseline modeling for as long as the THP will remain active. For portions of the Project Area not subject to THPs (or over time periods for which THPs will not be active), baseline carbon stocks must be modeled by taking into account any applicable requirements of the California Forest Practice Rules and all other applicable laws, regulations, and legally binding commitments that could affect onsite carbon stocks. On a case-by-case basis, the California Department of Forestry and Fire Protection (CAL FIRE) may assist Project Operators in identifying minimum carbon stocking levels that would be effectively required under California Forest Practice Rules.

**Modeling Financial Constraints**

Harvest assumptions included in the model must be financially viable. The Project Operator must demonstrate that the growth and harvesting regime assumed for the *preliminary unadjusted baseline* is financially feasible through one of the following means:

1. A financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints. Cost and revenue variables in the financial analysis may be based on regional norms or on documented costs and returns for the Project Area or other properties in the project's Assessment Area.
2. Providing evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years. The evidence must demonstrate that harvesting activities have taken place on at least one other comparable site with:
    a. Slopes that do not exceed slopes in the Project Area by more than ten percent
    b. An equivalent zoning class to the Project Area
    c. Comparable species composition to the Project Area (i.e. within 20 percent of project species composition based on trees per acre)
    d. Similar access by road, cable, or helicopter

**Step 3- Generate a *Standardized Unadjusted Baseline***

The periodic modeled outputs from the *preliminary unadjusted baseline* must be standardized according to the following guidance for each carbon pool. The result will be a *standardized unadjusted baseline* for each carbon pool (including both above-ground and below-ground portions of standing live carbon stocks).

*Above-ground standing live carbon stocks*. The periodic modeled outputs for above-ground standing live carbon stocks must be either averaged or converted to a straight-line approximation reflective of legal constraints.

If legal constraints do *not* result in an upward trend in above-ground standing live carbon stocks, then the periodic model outputs must be averaged using Equation 6.5.

If legal constraints do result in an increasing trend of above-ground standing live carbon stocks, beginning at the project start date, then the periodic model outputs may be standardized using a straight line approximation, as defined in Equation 6.6. The approximation must consist of two line segments. The first of the line segments must initiate at the initial inventory at the project start date and terminate at the point where carbon stocks reach their highest legally required level. The second segment is a straight line with a constant value, defined by the terminus of the first line segment, for the balance of the 100-year modeling timeframe.

**Equation 6.5.** Formula for Averaging *Preliminary Unadjusted Baseline* Carbon Stocks

**For all years *y*,** $\boldsymbol{SUB_y = \frac{\sum_{y=0}^{100} PUB_y}{100}}$

| *Where,* | | | Units |
|---|---|---|---|
| $SUB_y$ | = | *Standardized unadjusted baseline* for above-ground live carbon stocks (and other related and reported carbon stocks as shown below) value for year *y (*including the start date at y=0*)* | $tCO_2e$/acre |
| $PUB_y$ | = | *Preliminary unadjusted baseline* value for year *y.* $PUB_0$ represents the initial carbon stocks at the project start date | $tCO_2e$/acre |

**Equation 6.6.** Formula for Approximating *Preliminary Unadjusted Baseline* Carbon Stocks as a Straight-Line Trend

**For years *y* < Y,** $\boldsymbol{SUB_y = SS + y \times \frac{ES-SS}{Y}}$

**For years *y* ≥ Y,** $\boldsymbol{SUB_y = ES}$

| *Where,* | | | Units |
|---|---|---|---|
| $SUB_y$ | = | *Standardized Unadjusted Baseline* value for year *y* | $tCO_2e$/acre |
| Y | = | Time in years between the project start date and the year at which the highest legally required stocking level is reached for above-ground standing live carbon stocks. This is determined by modeling a forest growth and yield simulation that includes legal and financial constraints (in Step 2, above) | years |
| SS | = | Starting stocks = $PUB_0$ | $tCO_2e$/acre |
| ES | = | Ending stocks = The highest legally required stocking level, as determined in Step 2 | $tCO_2e$/acre |

*Below-ground standing live carbon stocks*. The below ground portion of the standing live carbon stocks must be standardized in the same way as the above-ground standing live carbon stocks, i.e., either averaged (Equation 6.5), or calculated with an upward-sloping line to a potential terminus (Equation 6.6).

*The above and below-ground portions of standing dead carbon stocks*. Standing dead carbon stocks shall be set at the quantity of carbon stocks present in the standing dead carbon stock pool at the project start date. Exceptions may be provided, at the Reserve's discretion, if compelling justification can be provided that standing dead carbon stocks are likely to fluctuate substantially as part of the project's baseline Standing dead stocks are not adjusted based on adjustments to the standing live carbon stocks.

*Carbon stocks in the above and below-ground portions of standing live trees harvested for wood products*. The carbon stocks shall be calculated as the average of the periodic outputs for the entire 100-year modeling if the above-ground live tree carbon stocks do not result in an upward trend.

If the carbon stocks in above-ground standing live carbon stocks results in an upward trend, the carbon stocks shall be calculated as an average from the start date to the highest point of the above-ground standing live carbon stocks. A separate average of carbon stocks in both the above and below-ground portions of standing live trees harvest for wood products between the highest point of the above-ground standing live carbon stocks and the end point of the 100-year modeling shall be calculated, as applicable

*Carbon stocks in the bole portion of trees harvested for wood products*. For upward-sloping lines, the values shall be based on the carbon stocks harvested to the legal constraint terminus and be based on the average carbon stocks from the terminus to the balance of the 100-year modeling (if applicable).

**Step 4 – Apply Performance-Standard Criteria**

Once the components of the *standardized unadjusted baseline* are determined in Step 3, the above-ground standing live component must be adjusted to conform to a set of performance standard criteria, as described below. The result is a *standardized adjusted baseline* for above-ground standing live carbon stocks. Other reported carbon pools are adjusted in Step 5.

The performance standard criteria establish minimum above-ground standing live carbon stock values for the baseline in each year, regardless of what is legally and financially viable. The elements of the performance standard are:

- *The High Stocking Reference.* The High Stocking Reference is a measure of carbon stocks in above-ground standing live biomass over the 10 years preceding the project start date. It governs baseline carbon stocks in certain instances where above-ground standing live carbon stocks have declined prior to the start date. See further guidance below on how to determine the High Stocking Reference.

- *Comparison of initial carbon stocks to Common Practice*. If the *standardized unadjusted baseline* for above-ground standing live carbon stocks was averaged (i.e. it was determined according to Equation 6.5), then the *standardized adjusted baseline* may depend on how the initial carbon stocks compare to Common Practice levels (see

guidance below for how to determine Common Practice). For projects whose initial carbon stocks are above Common Practice, the *standardized adjusted baseline* for above-ground standing live carbon stocks may not be below Common Practice. For projects whose initial carbon stocks are below Common Practice, the *standardized adjusted baseline* for above-ground standing live carbon stocks may not be below either (1) the initial inventory level or (2) the High Stocking Reference, whichever is greater. See Equation 6.7 and Equation 6.8 below.

- *Comparison of initial carbon stocks to stocks on other landholdings*. In addition to Common Practice constraints, if the initial above-ground standing live carbon stocks in the Project Area differ substantially (by more than 20 percent) from stocking levels on a Project Operator's other landholdings (within the same Logical Management Unit, defined below), then the *standardized adjusted baseline* for above-ground standing live carbon stocks may not be below a level determined by stocking levels on the other landholdings (Equation 6.7 and Equation 6.8).

The procedure for determining the *standardized adjusted baseline* depends on whether the *standardized unadjusted baseline* for above-ground standing live carbon stocks was determined as an average (i.e. according to Equation 6.5), or an upward sloping straight-line trend (i.e. according to Equation 6.6).

*Where the* standardized unadjusted baseline *for above-ground standing live carbon stocks was determined using Equation 6.5*:

- If the project's initial above-ground standing live carbon stocks ($PUB_0$) are above Common Practice, use Equation 6.7 to determine the *standardized adjusted baseline*.
- If the project's initial above-ground standing live carbon stocks ($PUB_0$) are below Common Practice, use Equation 6.8 to determine the *standardized adjusted baseline*.

In both cases, values must be determined for all years, *y*, starting with zero (the start date of the project) and ending with 100.

**Equation 6.7.** Determining the *Standardized Adjusted Baseline* for Above-Ground Live Carbon Stocks Where Initial Stocks Are Above Common Practice

$$\boldsymbol{SAB_y = MAX\left(CP, MIN(PUB_0, CP + PUB_0 - WCS), SUB_y\right)}$$

| *Where,* | | | Units |
|---|---|---|---|
| $SAB_y$ | = | *Standardized adjusted baseline* for above-ground standing live carbon stocks value in year *y* | $tCO_2e$/acre |
| CP | = | Common Practice (determined according to the guidance below) | $tCO_2e$/acre |
| $PUB_0$ | = | Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 1) | $tCO_2e$/acre |
| WCS | = | Weighted average above-ground standing live carbon stocks per acre for all Project Operator (and affiliate) landholdings within the same Logical Management Unit as the Project Area. Instructions for calculating WCS are provided below | $tCO_2e$/acre |
| $SUB_y$ | = | Value of the *standardized unadjusted baseline* for year *y,* as determined in Step 2 | $tCO_2e$/acre |

**Equation 6.8.** Determining the *Standardized Adjusted Baseline* for Above-Ground Live Carbon Stocks Where Initial Stocks Are Below Common Practice

$$SAB_y = MAX\left(MAX(HSR, PUB_0), MIN(CP, WCS), SUB_y\right)$$

| *Where,* | | | Units |
|---|---|---|---|
| $SAB_y$ | = | *Standardized adjusted baseline* for above-ground standing live carbon stocks value in year *y* | $tCO_2e$/acre |
| HSR | = | "High Stocking Reference" for the Project Area. See guidance below for how the HSR is determined | $tCO_2e$/acre |
| CP | = | Common Practice (determined according to the guidance below) | $tCO_2e$/acre |
| $PUB_0$ | = | Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 1) | $tCO_2e$/acre |
| WCS | = | Weighted average above-ground standing live carbon stocks per acre for all Project Operator (and affiliate) landholdings within the same Logical Management Unit as the Project Area. Instructions for calculating WCS are provided below | $tCO_2e$/acre |
| $SUB_y$ | = | Value of the *standardized unadjusted baseline* for year *y,* as determined in Step 2 | $tCO_2e$/acre |

*Where the* standardized unadjusted baseline *for above-ground standing live carbon stocks was determined using Equation 6.6*:

- The *standardized adjusted baseline* (SAB*y*) may be determined according to Equation 6.6, substituting SAB*y* for SUB*y* and *using the formula in Equation 6.9 to determine starting stocks*.

**Equation 6.9.** Formula for Determining Starting Stocks for the *Standardized Adjusted Baseline*

$$SS = MAX(PUB_0, HSR, WCS)$$

| *Where,* | | | Units |
|---|---|---|---|
| SS | = | Starting stocks for use in Equation 6.6 | $tCO_2e$/acre |
| $PUB_0$ | = | Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 1) | $tCO_2e$/acre |
| HSR | = | "High Stocking Reference" for the Project Area. See guidance below for how the HSR is determined | $tCO_2e$/acre |
| WCS | = | Weighted average above-ground standing live carbon stocks per acre for all Project Operator (and affiliate) landholdings within the same Logical Management Unit as the Project Area. Instructions for calculating WCS are provided below | $tCO_2e$/acre |

### *Determining the High Stocking Reference*

The High Stocking Reference is defined as 80 percent of the highest value for above-ground standing live carbon stocks per acre within the Project Area during the preceding 10-year period. To determine the High Stocking Reference, the Project Operator must document changes in the Project Area's above-ground standing live carbon stocks over the preceding 10 years, or for as long as the Project Operator has had control of the stocks, whichever is shorter. Figure 6.2 presents a graphical portrayal of a High Stocking Reference determination.

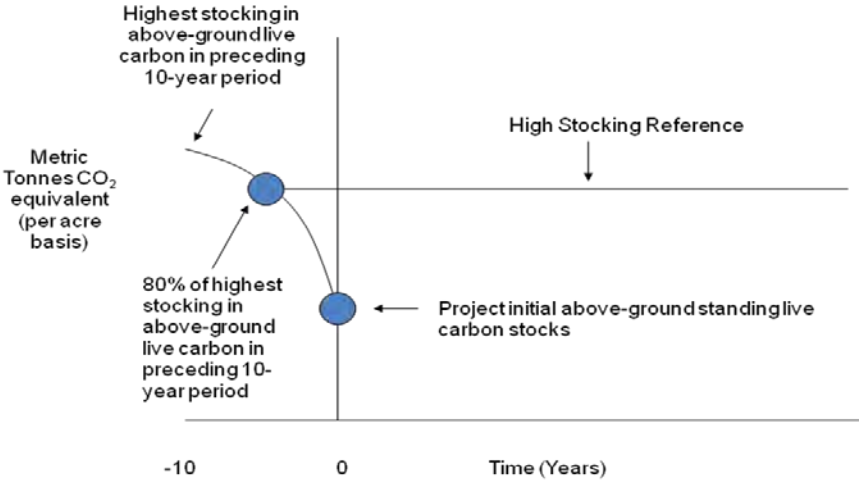



**Figure 6.2.** Determining a Project Area's High Stocking Reference

* It is possible for the High Stocking Reference to be higher than Common Practice, even where initial live-tree carbon stocks for the project are below Common Practice.

### *Determining Common Practice*

Common Practice refers to the average stocks of above-ground standing live carbon associated with the Assessment Area(s) covered by the Project Area. Common Practice statistics are calculated from United States Forest Service Forest Inventory and Analysis (USFS FIA) program. The Common Practice statistic applicable to a project can be found by consulting the Assessment Area Resource File on the Reserve's FPP webpage. If the Project Area covers multiple Assessment Areas, Common Practice must be calculated as the average of the values for each Assessment Area, weighted by the percentage of the Project Area that falls within each Assessment Area.

### *Determining the Weighted Carbon Stocks (WCS) Value*

The performance standard for an IFM project may depend on whether the Project Area's standing live carbon stocks are substantially greater or less than standing live carbon stocks on other lands held by the Project Operator. The "weighted carbon stocks" (WCS) value in Equation 6.7 and Equation 6.8 is used to make this comparison. WCS represents the weighted average above-ground standing live carbon stocks, on a per acre basis, for comparable entity-owned lands within the same Logical Management Unit (LMU) as the Project Area.

An "LMU" is defined as all land that the Project Operator and its Affiliate(s) either own in fee or hold timber rights on within the same Assessment Area(s) in which the Project Area is located, or an explicitly defined planning subunit characterized by having unique biological, geographical, and/or geological attributes, generally delimited by watershed boundaries and/or elevational zones, and containing unique road networks. In addition, an LMU must:

- Be a sustainable planning subunit as demonstrated by inventory reports and growth and harvest projections for the LMU.
- Have documented harvesting rates in the past ten years (averaged for either volume or area on an annual basis) within 20 percent of the annualized area or volume projected for harvest (a valid projection must be between ten years and 30 years). If the LMU, or

any portion of an LMU, was acquired less than ten years previously, documented rates must include whatever history exists and extend out into time with a management plan that has been approved by an appropriate state agency or certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System that demonstrates sustainable harvest levels for a minimum of 20 to 30 years.

- Where uneven aged management is the dominant harvest method, have between 33 percent and 66 percent of the forested stands exceeding the retention standards identified in the growth and harvest projections by a minimum of 25 percent (basal area).

If an explicit, existing LMU containing the Project Area cannot be identified, the Project Operator must define the LMU by identifying all lands where the Project Operator and its affiliate(s) either own in fee or hold timber rights on within the same Assessment Area(s) covered by the Project Area.

To calculate WCS, the Project Operator must estimate the above-ground standing live carbon stocks per acre for the entire LMU containing the Project Area (including the Project Area itself). This can be done using either existing inventory data, or a stratified vegetation-type analysis.

*Option 1: Calculating WCS Using Inventory Data*

If sufficient inventory data for LMU lands exist to quantify above-ground standing live carbon stocks for the entire LMU, then the formula in Equation 6.10 may be used to calculate WCS.

**Equation 6.10.** Formula for WCS Using Inventory Data

$$If \left|\left(1 - \frac{ECS}{PUB_0}\right)\right| \leq 0.2, then\ WCS = PUB_0$$

$$If \left|\left(1 - \frac{ECS}{PUB_0}\right)\right| > 0.2, then\ WCS = \frac{PUB_0 \cdot PA + ECS \cdot EA}{PA + EA}$$

*Where,*

| | | | Units |
|---|---|---|---|
| WCS | = | Weighted average above-ground standing live carbon stocks per acre within the LMU containing the Project Area | $tCO_2e$/acre |
| $PUB_0$ | = | Initial above-ground standing live carbon stocks per acre within the Project Area | $tCO_2e$/acre |
| PA | = | Size of the Project Area | acres |
| ECS | = | Above-ground standing live carbon stocks per acre within the LMU *but excluding the Project Area* (EA), as determined from existing inventory data | $tCO_2e$/acre |
| EA | = | Size of the LMU, e*xcluding the Project Area* | acres |

*Option 2: Calculating WCS Using Stratified Vegetation-Type Analysis*

Project Operators that do not have sufficient inventory data for the LMU must conduct a stratified vegetation-type analysis to calculate WCS. To conduct this analysis, all landholdings within the LMU – including the Project Area – must be divided into vegetation types and size class/canopy cover categories as delimited in Table 6.2, with a resolution for classification no greater than 40 acres. Each vegetation class has a "carbon rating" provided by the Reserve in Table 6.2. WCS must be calculated using the ratio of average carbon stocking on LMU lands relative to carbon stocking on Project Area lands (referred to as the "stratified carbon weighting factor" or SWF).The required formulas are specified in Equation 6.11 and Equation 6.12.

**Equation 6.11.** Formula for WCS Using Stratified Vegetation-Type Analysis

$$\boldsymbol{If}\ |(\mathbf{1}-\boldsymbol{SWF})| \leq \mathbf{0.2}, \boldsymbol{then}\ \boldsymbol{WCS} = \boldsymbol{PUB_0}$$

$$\boldsymbol{If}\ |(\mathbf{1}-\boldsymbol{SWF})| > 0.2, then\ WCS = \frac{\boldsymbol{PUB_0 \cdot PA + SWF \cdot PUB_0 \cdot EA}}{\boldsymbol{PA + EA}}$$

*Where,*

| | | | Units |
|---|---|---|---|
| WCS | = | Weighted average above-ground standing live carbon stocks per acre within the LMU containing the Project Area | $tCO_2e$/acre |
| $PUB_0$ | = | Initial above-ground standing live carbon stocks per acre within the Project Area | $tCO_2e$/acre |
| PA | = | Size of the Project Area | acres |
| SWF | = | Stratified carbon weighting factor for the LMU (from Equation 6.12 below) | $tCO_2e$ |
| EA | = | Size of the LMU, e*xcluding the Project Area* | acres |

**Equation 6.12.** Formula for LMU Stratified Carbon Weighting Factor (SWF)

$$\boldsymbol{SWF} = \frac{\sum_i(\boldsymbol{PA_i \times CR_i})}{\sum_i \boldsymbol{PA_i}} \div \frac{\sum_i(\boldsymbol{EA_i \times CR_i})}{\sum_i \boldsymbol{EA_i}}$$

*Where,*

| | | | Units |
|---|---|---|---|
| SWF | = | Stratified carbon weighting factor for the LMU | $tCO_2e$ |
| $PA_i$ | = | Size of the Project Area in forest vegetation type *i* (from Table 6.2) | acres |
| $EA_i$ | = | Size of the LMU, e*xcluding the Project Area,* in forest vegetation type *i* (from Table 6.2) | acres |
| $CR_i$ | = | Carbon rating for forest vegetation type *i* (from Table 6.2) | $tCO_2e$ |

**Table 6.2.** Vegetation Classes for Stratification

| Forest Vegetation Description | Average Diameter (Breast Height) | Average Canopy Cover | Carbon Rating (metric tonnes $CO_2e$) |
|---|---|---|---|
| Brush | 0" | NA | 0 |
| Regeneration | 3" | NA | 0.5 |
| Pole-sized Trees | 6" - 12" | < 33% | 2 |
| Pole-sized Trees | 6" - 12" | 33% - 66% | 4 |
| Pole-sized Trees | 6" - 12" | >66% | 6 |
| Small Sawlogs | 12" - 20" | < 33% | 4 |
| Small Sawlogs | 12" - 20" | 33% - 66% | 8 |
| Small Sawlogs | 12" - 20" | >66% | 12 |
| Large Sawlogs | 20" - 36" | < 33% | 8 |
| Large Sawlogs | 20" - 36" | 33% - 66% | 16 |
| Large Sawlogs | 20" - 36" | >66% | 24 |
| Very Large Trees | >36" | < 33% | 16 |
| Very Large Trees | >36" | 33% - 66% | 32 |
| Very Large Trees | >36" | >66% | 48 |

### Step 5 – Proportionally Adjust Other Reported Carbon Stocks

The *standardized adjusted baseline* for other reported carbon stocks must be determined by adjusting carbon stock values to reflect the *standardized adjusted baseline* for above-ground standing live carbon stocks. The guidance for adjusting the other reported carbon stocks is shown in Table 6.3.

**Table 6.3.** Guidance for Adjusting Other Carbon Pools

| Carbon Pool | Relationship to Adjustments of Above-Ground Live Carbon Stocks | Adjustment |
|---|---|---|
| Below-Ground Standing Live Carbon Stocks | Directly Proportional | $\boldsymbol{SAB_{bg,y} = \left(SAB_{ag,y}/SUB_{ag,y}\right) \times SUB_{bg,y}}$ |
| | | *Where,*<br><br>$SAB_{bg,y}$ = *Standardized Adjusted Baseline* for below-ground standing live carbon stocks in year *y*<br>$SAB_{ag,y}$ = *Standardized Adjusted Baseline* for above-ground standing live carbon stocks in year *y*<br>$SUB_{ag,y}$ = *Standardized Unadjusted Baseline* for above-ground standing live carbon stocks in year *y*<br>$SUB_{bg,y}$ = *Standardized Unadjusted Baseline* for below-ground standing live carbon stocks in year *y* |
| Above and Below-Ground Standing Dead Carbon Stocks | N/A | No adjustment is conducted.<br>Above and below-ground standing dead carbon stocks remain constant with inventories of above and below-ground standing dead carbon stocks at the project start date. Exceptions may be allowed as described previously. Standing dead carbon stocks are not adjusted based on changes to standing live carbon stocks |
| Harvested Above-Ground Standing Live Carbon Stocks | Inversely Proportional | $\boldsymbol{SAB_{ht,y} = \dfrac{\left(SUB_{ht,y}/SUB_{ag,y}\right)}{\left(SAB_{ag,y}/SUB_{ag,y}\right)}}$ |
| | | *Where,*<br><br>$SAB_{ht,y}$ = *Standardized Adjusted Baseline* for harvested above and below-ground standing live carbon stocks in year *y*<br>$SUB_{ht,y}$ = *Standardized Unadjusted Baseline* for harvested above and below-ground standing live carbon stocks in year *y*<br>$SUB_{ag,y}$ = *Standardized Unadjusted Baseline* for above-ground standing live carbon stocks in year *y*<br>$SAB_{ag,y}$ = *Standardized Adjusted Baseline* for above-ground standing live carbon stocks in year *y* |
| Harvested Bole Portion of Above- | Inversely Proportional | $\boldsymbol{SAB_{htb,y} = \dfrac{\left(SUB_{htb,y}/SUB_{ag,y}\right)}{\left(SAB_{ag,y}/SUB_{ag,y}\right)}}$ |

| | | |
|---|---|---|
| Ground Standing Live Carbon Stocks | | *Where,*<br><br>$SAB_{htb}$ = *Standardized Adjusted Baseline* for the bole portion of harvested above and below-ground standing live carbon stocks in year *y*<br>$SUB_{htb,y}$ = *Standardized Unadjusted Baseline* for the bole portion of harvested above and below-ground standing live carbon stocks in year *y*<br>$SUB_{ag,y}$ = *Standardized Unadjusted Baseline* for above-ground standing live carbon stocks in year *y*<br>$SAB_{ag,y}$ = *Standardized Adjusted Baseline* for above-ground standing live carbon stocks in year *y* |

**Step 6 – Combine All Standardized Adjusted Baseline Components**

The *Final Baseline* is the sum of *standardized adjusted baselines* for all reported *onsite* carbon stocks and must include:

- Above-ground standing live carbon stocks
- Below-ground standing live carbon stocks
- Above- and below-ground standing dead carbon stocks

The standardized adjusted baselines for harvested standing live carbon stocks (above and below-ground) and the bole portion of harvested standing live carbon stocks must be maintained separately from the carbon stocks listed above. The reporting of harvested carbon stocks is conducted separately from other reported carbon stocks.

### 6.2.2 Estimating Baseline Onsite Carbon Stocks – Public Lands

For Improved Forest Management Projects on lands owned or controlled by public agencies, the baseline must be estimated by:

1. Conducting an initial forest carbon inventory for the Project Area
2. Projecting future changes to Project Area forest carbon stocks by:
   a. Extrapolating from historical trends
   b. Anticipating how current and future public policy will affect onsite carbon stocks

The method that results in the highest estimated carbon stock levels must be used to determine the baseline.

To extrapolate from historical trends:

- For Project Areas that have a ten-year history of declining carbon stocks, the baseline must be defined by the average of the carbon stocks over the past ten years and considered static for the project life (i.e. the same level of carbon stocks is assumed in every year).
- For Project Areas that demonstrate an increasing inventory of carbon stocks over the past ten years, the growth trajectory of the baseline shall continue until the forest (under the baseline stocks) achieves a stand composition consistent with comparable forested areas that have been relatively free of harvest over the past 60 years.

To anticipate how current and future public policy will affect onsite carbon stocks, the baseline must be modeled following the guidance in the Quantification Guidance, incorporating

constraints imposed by all applicable statutes, regulations, policies, plans and Activity-Based Funding.

### 6.2.3 Estimating Baseline Carbon in Harvested Wood Products

To estimate the amount of baseline carbon transferred to long-term storage in wood products each year, the following steps must be performed:

1. Determine the *average* amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year of the baseline over 100 years. The result will be a uniform estimate of harvested carbon in each year of the baseline. This estimate is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.
    a. For projects on private lands, the amount of harvested carbon must be derived from the growth and harvesting regime used to develop the baseline for onsite carbon stocks in Section 6.2.1.
    b. For projects on public lands, the amount of harvested carbon must be derived from the growth and harvesting regime assumed in the baseline for onsite carbon stocks derived in Section 6.2.2.
2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.2.4 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Improved Forest Management Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model or a stand table projection to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Guidance for projecting forest inventory data is identified in the Quantification Guidance.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in the Quantification Guidance.

### 6.2.5 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.2.4).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.2.6 Quantifying Secondary Effects

For Improved Forest Management Projects, significant Secondary Effects can occur if a project reduces harvesting in the Project Area, resulting in an increase in harvesting on other properties. Changes in energy-related emissions, which could result from a Forest Project causing consumers of forest products to increase or decrease their use of alternative materials, are not accounted for because it is assumed that energy sector emissions will be capped in the relatively near future under a regulatory cap-and-trade system.

Equation 6.13 must be used to estimate Secondary Effects for Improved Forest Management Projects.

**Equation 6.13.** Secondary Effects Emissions

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) > 0, then\ SE_y = 0$$

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) < 0, then\ SE_y = (AC_{hv,y} - BC_{hv,y}) \times 20\%$$

| *Where,* | | | Units |
|---|---|---|---|
| $SE_y$ | = | Estimated annual Secondary Effects (used in Equation 6.1) | $tCO_2e$ |
| $AC_{hv,n}$ | = | 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 in Step 1 of Section 6.2.3 | $tCO_2e$ |
| y | = | Current year or reporting period | |

## 6.3 Avoided Conversion Projects

### 6.3.1 Estimating Baseline Onsite Carbon Stocks

The baseline for Avoided Conversion Projects is a projection of onsite forest carbon stock losses that would have occurred over time due to the conversion of the Project Area to a non-forest land use. Estimating the baseline for Avoided Conversion Projects involves two steps:

1. Characterizing and projecting a baseline
2. Adjusting the baseline based on conversion risk

#### Step 1 – Characterizing and Projecting the Baseline

Project Operators must characterize and project the baseline by:

1. Clearly specifying an alternative highest-value land use for the Project Area, as identified by an appraisal (as required by the Forest Project Protocol). The appraisal must include accompanying documentation that demonstrates the type of anticipated land use conversion is legally permissible. Such documentation must fall into at least one of the following categories:

    a. Documentation indicating that the current land use policies, including zoning and general plan ordinances, and other local and state statutes and regulations,

permit the anticipated type of conversion.

b. Documentation indicating that the Project Operator has obtained all necessary approvals from the governing county to convert the Project Area to the proposed type of non-forest land use (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.).

c. Documentation indicating that similarly situated forestlands within the project's Assessment Area were recently able to obtain all necessary approvals from the governing county, state, or other governing agency to convert to a non-forest land use (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.)

2. Estimating the rate of conversion and removal of onsite standing live and dead carbon stocks. The rate of conversion and removal of onsite standing live and dead carbon stocks must be estimated by either:

   a. Referencing planning documentation that has been approved and permitted by the appropriate planning department for the Project Area (e.g. construction documents or plans) that specifies the timeframe of the conversion and intended removal of forest cover on the Project Area; or

   b. In the absence of specific documentation, identifying a default annual conversion rate for carbon in standing live and dead carbon stocks from Table 6.4. The default value is subject to any legal constraints, which must be incorporated in modeling the project's baseline.

**Table 6.4.** Default Avoided Conversion Rates for Standing Live and Dead Carbon Stocks

| Type of Conversion Identified in Appraisal | Total Conversion Impact | Annual Rate of Conversion |
|---|---|---|
| | This is the assumed total effect over time of the conversion activity on standing live and dead carbon stocks. (The total conversion impact is amortized over a 10-year period to determine the annual rate of conversion in the next column.) | This is the assumed annual rate of the conversion activity on standing live and dead carbon stocks. The percentages below are multiplied by the initial standing and dead carbon stocks for the project on an annual basis for the first 10 years of the project. |
| **Residential** | Estimate using the following formula:<br><br>TC% = (min(1,(P*3) / PA))<br><br>*Where,*<br>TC = % total conversion (TC cannot exceed 100%)<br>PA = the Project Area (acres) identified in the appraisal<br>P = the number of unique parcels that would be formed on the Project Area as identified in the appraisal.<br>* Each parcel is assumed to deforest 3 acres | Estimate using the following formula:<br><br>ARC = TC / 10<br><br>*Where,*<br>ARC = % annual rate of conversion<br>TC = % total conversion |

| | of forest vegetation | |
|---|---|---|
| **Mining and agricultural conversion, including pasture or crops** | 90% | 9.0% |
| **Golf course** | 80% | 8.0% |
| **Commercial buildings** | 95% | 9.5% |

A computer simulation, based on 2a or 2b above, must be conducted to project changes in onsite standing live and dead carbon stocks over 100 years. The computer simulation of the onsite standing live and dead carbon stocks must approximate the identified rate of conversion over time to estimate changes in standing live and dead carbon stocks, beginning with the Project Area's initial onsite standing live and dead carbon stocks. If the projected conversion rate does not result in a complete removal of onsite standing live and dead carbon stocks, the baseline projection must account for any residual forest carbon value as a steady condition for the balance of a 100-year projection. See Figure 6.3 for an example of a projected decline in standing live and dead carbon stocks for a hypothetical project that avoids agricultural conversion, using an appropriate conversion rate from Table 6.5.

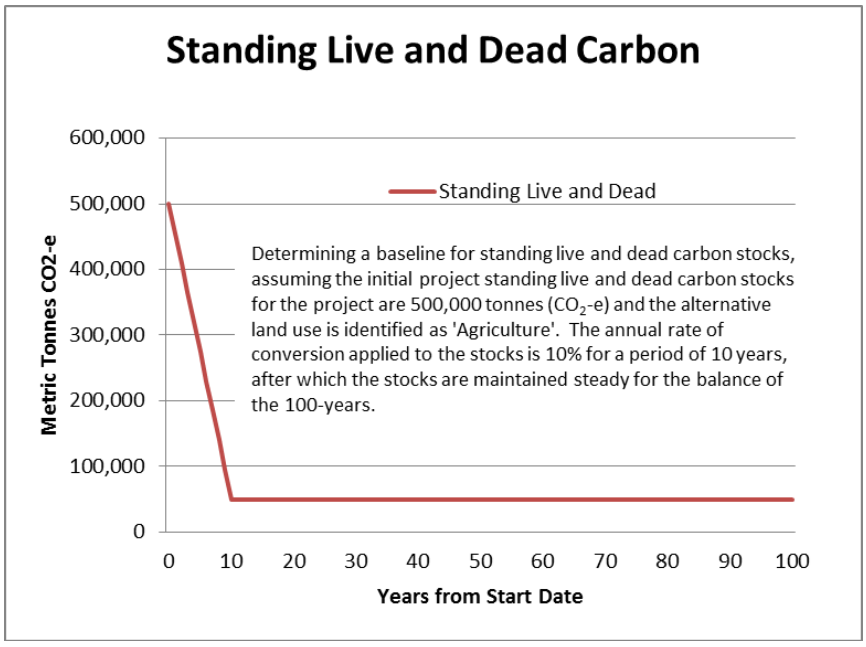



**Figure 6.3.** Example of an Avoided Conversion Project Baseline for Onsite Standing Live and Dead Carbon Stocks

3. Estimating the rate of soil carbon emissions (optional):
   With the exception of histosols, soil carbon emissions can only be quantified for conversion to agriculture at this time. Soil carbon emissions associated with conversion to residential and commercial are allowed for histosols as well. The amount of soil carbon and the rate of soil carbon emissions are dependent upon the soil type (Order) and the conversion activity. Emissions from soil carbon are estimated by applying the default emissions estimators from Table 6.5 below to the estimates of soil carbon in the Project Area. Table 6.5 provides an estimated percentage emitted as the result of conversion and presents the rate of emissions associated with each soil order.

**Table 6.5.** Soil Carbon Emissions Estimators by Soil Order

| *Soil Order* | | *Alfisol* | *Andisol* | *Inceptisol* | *Mollisol* | *Spodosol* | *Ultisol* | *Histosol* |
|---|---|---|---|---|---|---|---|---|
| **Estimated Emissions Associated with Conversion Activity** | **Agriculture** | 30% | 30% | 30% | 30% | 30% | 30% | 80% |
| | **Residential/ Commercial/ Industrial** | 0% | 0% | 0% | 0% | 0% | 0% | 80% |
| **Rate of Estimated Emissions** | | 100% in first 10 years. | 100% in first 10 years. | 100% in first 10 years. | 100% in first 10 years. | 100% in first 10 years. | 100% in first 10 years. | 10% per 10-year period. |

A weighted estimate of emissions must be conducted where more than one soil order is found in the Project Area.

**Table 6.6.** Example of the Computation of Weighted Soil Carbon Estimates

| Soil Order and Project Acres | Estimated Soil $CO_2e$ (MT) per Acre | Rate of Emissions | Total Emissions | Soil Carbon Inventory and Emissions | Project Start Date | 10 Years | 20 Years | 30 Years | 40 Years | 50 Years | 60 Years | 70 Years | 80 Years | 90 Years | 100 Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Histosols 500 | 285 | 8% of original inventory estimate every 10 years | 80% | $CO_2e$ Metric Tons Total | 142,500 | 131,000 | 119,700 | 108,300 | 96,900 | 85,500 | 74,100 | 62,700 | 51,300 | 39,900 | 28,500 |
| | | | | Decadal Emissions | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 0 |
| Ultisols 500 | 60 | 30% of original inventory estimate in first 10 years | 30% | $CO_2e$ Metric Tons Total | 30,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 | 21,000 |
| | | | | Decadal Emissions | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Totals** | | | | | | | | | | | | | | | |
| 1000 | 172.5 | | | $CO_2e$ Metric Tons Total | 172,500 | 159,300 | 147,900 | 136,500 | 125,100 | 113,700 | 102,300 | 90,900 | 79,500 | 68,100 | 56,700 |
| | | | | Decadal Emissions | 20,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 | 11,400 |

The baseline trend of soil carbon stocks must be graphed to display the soil carbon stocks on an annual basis. Annual soil carbon emissions are derived from the decadal soil carbon emissions by dividing by ten. Figure 6.4 displays the baseline trend of soil carbon using the example presented in Table 6.6.

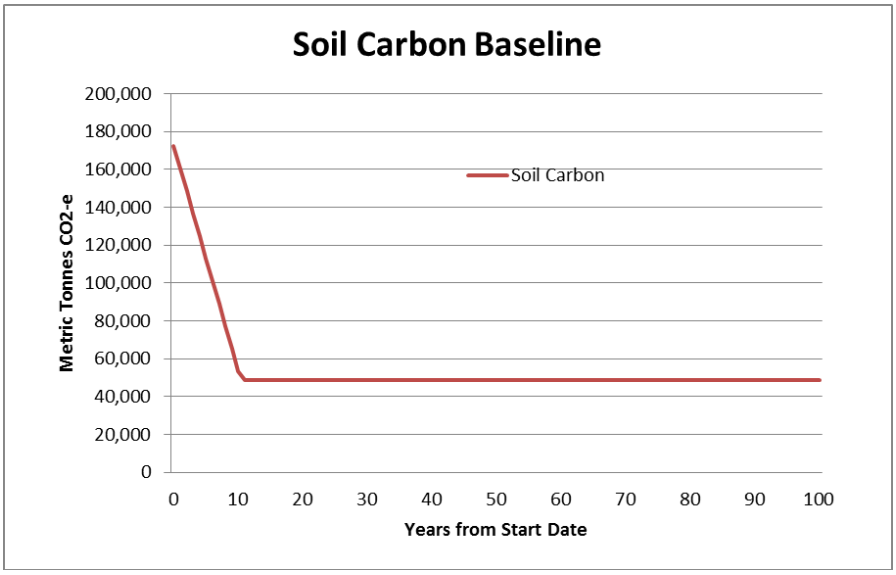



**Figure 6.4.** Example of an Avoided Conversion Project Baseline for Soil Carbon Stocks

The carbon stock trends for standing live carbon, standing dead carbon, and soil carbon are added together to determine a project baseline for the onsite carbon stocks. Figure 6.5 displays the baseline trend of soil carbon and standing live and dead carbon, using the example data provided above.

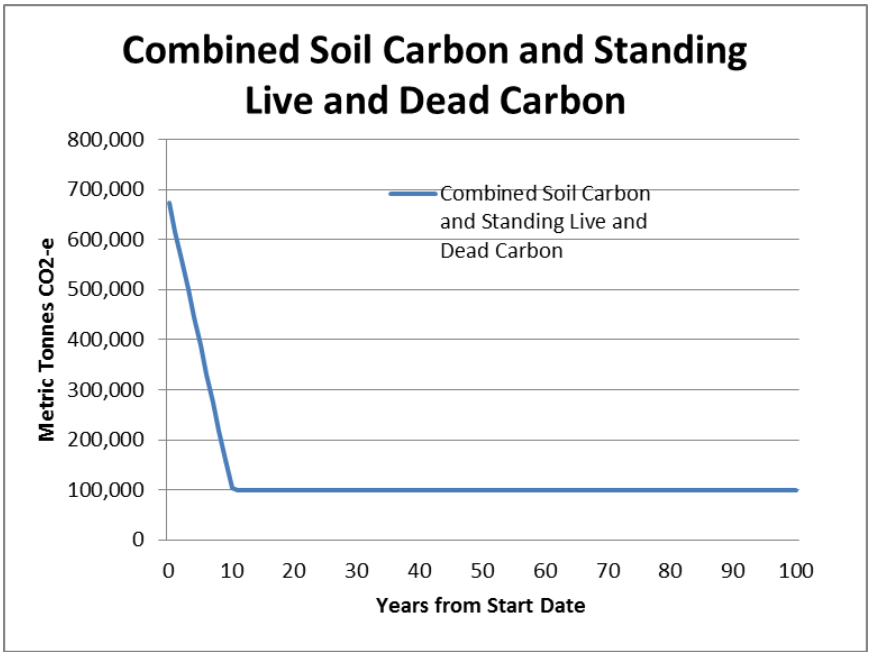



**Figure 6.5.** Example of an Avoided Conversion Project Baseline for the total Onsite Carbon Stocks

**Step 2 – Adjusting the Baseline Based on Conversion Risk**

If the fair market value of the anticipated alternative land use for the Project Area (as determined by the appraisal required in the Forest Project Protocol) is *not more than 80 percent greater* than the value of the current forested land use, then the baseline must be adjusted to reflect uncertainty about the risk of conversion.

**Equation 6.14.** Conversion Risk Adjustment Factor

**If** 0.4 < ((VA / VP) – 1) < 0.8, **then** CRA = [80% – ((VA / VP) – 1)] x 2.5
**If** ((VA / VP) – 1) > 0.8, **then** CRA = 0%
**If** ((VA / VP) – 1) < 0.4, **then** CRA = 100%

*Where,*

| | | |
|---|---|---|
| CRA | = | Conversion Risk Adjustment factor |
| VA | = | Appraised fair market value of the anticipated alternative land use for the Project Area |
| VP | = | Appraised fair market value of the current forested land use for the Project Area |

The baseline is adjusted by applying the Conversion Risk Adjustment factor to the unadjusted baseline determined in Step 1, using Equation 6.15 below.

**Equation 6.15.** Adjusted Baseline Onsite Carbon Stocks

$$\boldsymbol{BC_{onsite,y} = BLU_y + \left(IS - BLU_y\right) \times CRA}$$

*Where,*

| | | | Units |
|---|---|---|---|
| $BC_{onsite,\ y}$ | = | Adjusted baseline onsite carbon stocks in year y, for each of the 100 years calculated in the project's baseline | $tCO_2e$ |
| $BLU_y$ | = | Unadjusted baseline onsite carbon stocks in year y, for each of the 100 years calculated in the project's baseline (determine in Step 1, above) | $tCO_2e$ |
| IS | = | Initial onsite carbon stocks at the project start date | $tCO_2e$ |
| CRA | = | Conversion Risk Adjustment factor, as described above | % |

## 6.3.2 Estimating Baseline Carbon in Harvested Wood Products

Harvesting is assumed to occur in the baseline over time as the Project Area is converted to another land use. To estimate the baseline carbon transferred to long-term storage in harvested wood products each year:

1. Determine the amount of carbon in standing live carbon stocks (prior to delivery to a mill) that would have been harvested in each year, consistent with the rate of reduction in baseline standing live carbon stocks determined in Section 6.3.1 of the Forest Project Protocol. This projection is determined at the project outset, using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project.
2. On an annual basis, determine the amount of harvested carbon that would have remained stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.3.3 Determining Actual Onsite Carbon Stocks

Actual carbon stocks for Avoided Conversion Projects must be determined by updating the Project Area's forest carbon inventory. This is done by:

1. Incorporating any new forest inventory data obtained during the previous year into the inventory estimate. Any plots sampled during the previous year must be incorporated into the inventory estimate.
2. Using an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models are identified in the Quantification Guidance. Guidance for projecting forest inventory plot data using models is also provided in the Quantification Guidance.
3. Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year.
4. Applying an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the guidance in the Quantification Guidance.

### 6.3.4 Determining Actual Carbon in Harvested Wood Products

Perform the following steps to determine actual carbon in harvested wood products:

1. Determine the actual amount of carbon in standing live carbon stocks (prior to delivery to a mill) harvested in the current year (based on harvest volumes determined in Section 6.3.2 of the Forest Project Protocol).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements in the Quantification Guidance.

### 6.3.5 Quantifying Secondary Effects

Significant Secondary Effects for Avoided Conversion Projects can arise if the type of land use conversion that would have happened on the Project Area is shifted to other forest land.

To quantify Secondary Effects for Avoided Conversion Projects, Project Operators must quantify Secondary Effect emissions using Equation 6.16. The value for Secondary Effect emissions will always be negative or zero.

**Equation 6.16.** Secondary Effects Emissions

$$SE_y = (-1) \times 3.6\% \times (\Delta AC_{onsite} - \Delta BC_{onsite})$$ **or 0, whichever is lower**

*Where,*

| | | | Units |
|---|---|---|---|
| $SE_y$ | = | Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1) | $tCO_2e$ |
| $\Delta AC_{onsite}$ | = | Annual difference in actual onsite carbon as defined in Equation 6.1 | $tCO_2e$ |
| $\Delta BC_{onsite}$ | = | Annual difference in baseline onsite carbon as defined in Equation 6.1 | $tCO_2e$ |

# 7 Ensuring the Permanence of Credited GHG Reductions and Removals

The Reserve requires that credited GHG reductions and removals be effectively "permanent." For Forest Projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.

The Reserve ensures the permanence of GHG reductions and removals through three mechanisms:

1. The requirement for all Project Operators to monitor onsite carbon stocks, submit regular monitoring reports, and submit to regular third-party verification of those reports along with periodic verification site visits (as detailed in Sections 7 through 9 of this protocol) for the duration of the Project Life.
2. The requirement for all Project Operators to sign a Project Implementation Agreement with the Reserve, as described in Section 3.5, which obligates Project Operators to retire CRTs to compensate for reversals of GHG reductions and removals.
3. The maintenance of a Buffer Pool to provide insurance against reversals of GHG reductions and removals due to unavoidable causes (including natural disturbances such a fires, pest infestations or disease outbreaks).

GHG reductions and removals can be "reversed" if the stored carbon associated with them is released (back) to the atmosphere. Many biological and non-biological agents, both natural and human-induced, can cause reversals. Some of these agents cannot completely be controlled (and are therefore "unavoidable"), such as natural agents like fire, insects, and wind. Other agents can be controlled, such as the human activities like land conversion and over-harvesting. Under this protocol, reversals due to controllable agents are considered "avoidable". As described in this section, Project Operators are required to identify and quantify the risk of reversals from different agents based on project-specific circumstances. The resulting risk rating determines the quantity of Climate Reserve Tonnes (CRTs) that the project must contribute to the Reserve Buffer Pool to insure against reversals.

## 7.1 Definition of a Reversal

Project owners must demonstrate, through annual reporting and periodic site visit verification, that stocks associated with credited GHG reductions and removals are maintained for a period of time considered to be permanent (i.e.100 years). If the quantified GHG reductions and removals (i.e. $QR_y$ in Equation 6.1) in a given year are negative, and CRTs were issued to the Forest Project in any previous year, the Reserve will consider this to be a reversal regardless of the cause of the decrease. Planned thinning or harvesting activities, for example, may cause a reversal if they result in a negative value for $QR_y$.

## 7.2 Insuring Against Reversals

The Reserve requires Project Operators to insure against reversals, based on a project-specific risk evaluation. Currently, insurance must take the form of contributing CRTs to the Buffer Pool administered by the Reserve. In the future, the Reserve anticipates that other insurance instruments may be available to insure against reversals.

### 7.2.1 About the Buffer Pool

The Buffer Pool is a holding account for Forest Project CRTs, which 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 verified GHG reductions and removals. Each Forest Project's contribution is determined by a project-specific risk rating, as described in Section 7.2.2. If a Forest Project experiences an unavoidable reversal of GHG reductions and removals (as defined in Section 7.3), the Reserve will retire a number of CRTs from the Buffer Pool equal to the total amount of carbon that was reversed (measured in metric tons of $CO_2$-equivalent). The Buffer Pool therefore acts as a general insurance mechanism against unavoidable reversals for all Forest Projects registered with the Reserve.

### 7.2.2 Contributions to the Buffer Pool

Each time the Reserve issues CRTs for verified GHG reductions and removals achieved by a Forest Project, a certain percentage of those CRTs must be contributed to the Buffer Pool. The size of the contribution to the Buffer Pool will depend on the Forest Project's risk rating for reversals. For example, if a Forest Project is issued ten CRTs after annual verification, and the project's reversal risk rating is ten percent, then nine CRTs will be issued to the Project Operator's Reserve account and 1 CRT must be deposited in the Buffer Pool.

Project Operators must determine the reversal risk rating for a project by following the requirements and guidance in Appendix A. The risk rating must be determined prior to registration, and recalculated in every year the project undergoes a verification site visit (see Section 9.3.2).

Project Operators who record a Qualified Conservation Easement or Qualified Deed Restriction in conjunction with implementing a Forest Project will receive a lower risk rating (see Appendix A).

Project Operators may be able to reduce the risk rating through actions that lower the risk profile of their project. If a Forest Project's risk rating declines, the Reserve may distribute previously withheld Buffer Pool CRTs to the Project Operator in proportion to the reduced risk. Similarly, however, the Reserve may require additional contributions to the Buffer Pool if the risk rating increases, to ensure that all CRTs (including those issued in prior years) are properly insured.

### 7.2.3 Other Insurance Options for Reversals

It is the Reserve's expectation that other options to insure against reversals will develop for projects in the future. These options may include direct insurance. Alternative insurance mechanisms could be used to directly reduce the required Buffer Pool contributions for a project. The Reserve must review and approve alternative insurance mechanisms before they may be used.

## 7.3 Compensating for Reversals

The Reserve requires that all reversals be compensated through the retirement of CRTs. If a reversal associated with a Forest Project was unavoidable (as defined below), then the Reserve will compensate for the reversal on the Project Operator's behalf by retiring CRTs from the Buffer Pool. If a reversal was avoidable (as defined below) then the Project Operator must compensate for the reversal by surrendering CRTs from its Reserve account.

### 7.3.1 Unavoidable Reversals

An Unavoidable Reversal is any reversal not due to the Project Operator's negligence, gross negligence or willful intent, including wildfires or disease that are not the result of the Project Operator's negligence, gross negligence or willful intent. Requirements for Unavoidable Reversals are as follows:

1. If the Project Operator determines there has been an Unavoidable Reversal, it must notify the Reserve in writing of the Unavoidable Reversal within six months of its occurrence.
2. The Project Operator must explain the nature of the Unavoidable Reversal and provide a verified estimate of onsite carbon stocks within one year so that the reversal can be quantified (in units of $CO_2$-equivalent metric tons).

If the Reserve determines that there has been an Unavoidable Reversal, it will retire a quantity of CRTs from the Buffer Pool equal to size of the reversal in $CO_2$-equivalent metric tons (i.e. $QR_y$, as specified in Equation 6.1).

### 7.3.2 Avoidable Reversals

An Avoidable Reversal is any reversal that is due to the Project Operator's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the Project Area due to the Project Operator's negligence, gross-negligence or willful intent. Requirements for Avoidable Reversals are as follows:

1. If an Avoidable Reversal has been identified during annual monitoring, the Project Operator must give written notice to the Reserve within thirty days of identifying the reversal. Additionally, if the Reserve determines that an Avoidable Reversal has occurred, it shall deliver written notice to the Project Operator.
2. Within thirty days of receiving the avoidable reversal notice from the Reserve, the Project Operator must provide a written description and explanation of the reversal to the Reserve.
3. Within a year of receiving the avoidable reversal notice, the Project Operator must provide the Reserve with a verified estimate of current onsite carbon stocks;
4. Within four months of receiving the avoidable reversal notice, the Project Operator must retire a quantity of CRTs from its Reserve account equal to the size of the reversal in $CO_2$-equivalent metric tons (i.e. $QR_y$, as specified in Equation 6.1). In addition:
    a. The retired CRTs must be those that were issued to the Forest Project, or that were issued to other Forest Projects registered with the Reserve.
    b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.

## 7.4 Disposition of Forest Projects after a Reversal

If a reversal lowers the Forest Project's actual standing live carbon stocks below its approved baseline standing live carbon stocks, the Forest Project will automatically be terminated, as 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 carbon stocks are still above the approved baseline levels, it may continue without termination as long as the reversal has been compensated. The project must continue contributing to the Buffer Pool in future years based on its verified risk rating.

# 8 Project Monitoring

This section provides requirements and guidance on project monitoring, reporting rules and procedures.

## 8.1 Project Documentation

Project Operators must provide the following documentation to the Reserve in order to register a forest project.

- Project Submittal form
- Project Design Document
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form
- Verification Report
- Verification Statement
- Project Implementation Agreement

Project Operators must provide the following documentation each time a Forest Project is verified in order for the Reserve to issue CRTs for quantified GHG reductions.

- Verification Report
- Verification Statement
- Signed Attestation of Title form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form (Improved Forest Management projects only)

Project submittal forms can be found at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

All reports that reference carbon stocks must be submitted with the oversight of a Professional Forester, for jurisdictions with a Professional Forester law or regulation, or a Certified Forester, managed by the Society of American Foresters (see www.certifiedforester.org) so that professional standards and project quality are maintained. Any Professional Forester or Certified Forester preparing a project in an unfamiliar jurisdiction must consult with a Professional Forester or Certified Forester practicing forestry in that jurisdiction to understand all laws and regulations that govern forest practice within the jurisdiction. The Reserve may evaluate and approve alternative certification credentials if requested, but only for jurisdictions where professional forester laws or regulations do not exist. This requirement does not preclude the project's use of technicians or other unlicensed/uncertified persons working under the supervision of the Professional Forester

All projects shall submit a shapefile as a KML that matches the maps submitted to depict the Project Area. The project's reported acres shall be based on the shapefile submitted to the Reserve. The Reserve will create a file of all verified forest carbon projects on Google Maps for public dissemination.

### 8.1.1 Forest Project Design Document

The forest Project Design Document (PDD) is a required document for reporting information about a project. The document is submitted at the initial verification. A PDD template has been prepared by the Reserve and is available on the Reserve's website. The template is arranged to assist in ensuring that all requirements of the FPP are addressed. The template is required to be used by all projects. The template is designed to manage the varying requirements based on project type.

Each project must submit a PDD at the project's first verification. The Project Operator must include a general description of the methodology that will be incorporated by the Project Operator to update their inventory estimates on an annual basis per guidance in the Quantification Guidance on the FPP webpage for the reported carbon pools.

PDDs are intended to serve as the main project document that thoroughly describes how the project meets eligibility requirements, discusses the quantification methodologies utilized to generate project estimates, outlines how the project complies with terms for additionality and describes methods for updating inventory estimates and how permanence will be addressed, including how project reversal risks are calculated. All methodologies used by Project Operators and descriptions in the PDD must be clear in a way that facilitates review by verifiers, Reserve staff, and the public. PDDs must be of professional quality and free of incorrect citations, missing pages, incorrect project references, etc.

## 8.2 Monitoring Report

Monitoring is the process of regularly collecting and reporting data related to a project's performance. Annual monitoring of Forest Projects is required to ensure up-to-date estimates of project carbon stocks and provide assurance that GHG reductions or removals achieved by a project have not been reversed. Project Operators must conduct monitoring activities and submit monitoring reports according to the schedule and requirements presented in Section 8.3. Monitoring is required for a period of 100 years following the final issuance of CRTs to a project for quantified GHG reductions or removals.

For Forest Projects, monitoring activities consist primarily of updating a project's forest carbon inventory, entering the updated inventory into the Forest Project's Calculation Worksheet, and submitting it to the Reserve at frequencies defined in Section 10 under Reporting Periods. CRTs are only issued in years that the project data are verified, as described in Section 9.

A monitoring report must be prepared for each Reporting Period. Monitoring reports must be provided to verification bodies whenever a Forest Project undergoes verification. In addition, monitoring reports must be provided to the Reserve upon the completion of any Reporting Period for which verification will be deferred (e.g. if the Project Operator foregoes a desk-review verification). Monitoring reports must include an update of the project's calculation worksheet. The project's calculation worksheet includes:[17]

1. An updated estimate of the current year's carbon stocks in the reported carbon pools. Specific methods used to update the forest inventory must follow the inventory methodology approved at the time the project is registered. Modifications to inventory methodologies must be approved in advance by the Reserve. Any changes in inventory

[17] Reforestation Projects, as described in Section 6.1, can defer the items that are marked with an asterisk until the second site visit verification.

estimates associated with the use of the modified inventory methodology will need to be reconciled with previously verified project inventory estimates and baseline projections. . The update is determined by:
    a. Including any new forest inventory data obtained during the Reporting Period.
    b. *Applying growth estimates to existing inventory.
    c. Updating inventory estimates for harvest and/or disturbances that have occurred during the Reporting Period.
2. *The appropriate confidence deduction for the forest carbon inventory, as determined at the last full site visit verification for the project (following the Quantification Guidance). The same confidence deduction must be used in interim years between verification site visits.
3. *An estimate of current-year harvest volumes and associated carbon in harvested wood products.
4. *Estimated mill efficiency, as determined following the Quantification Guidance.
5. *The baseline carbon stock estimates for all required and optional carbon pools for the current year, as determined following the requirements in Section 6 and approved at the time of the project's registration.
6. An estimate of Secondary Effects, following calculation steps and/or factors provided in Section 6 and approved at the time of the project's registration.
7. The uncertainty discount for Avoided Conversion Projects, as determined following the requirements of Section 6.3 and approved at project registration. (Once a project is registered with the Reserve, the uncertainty discount does not change.)
8. *A preliminary calculation of total net GHG reductions and removals (or reversals) for the year, following the requirements in Section 6.
9. *The project's reversal risk rating, as determined following the requirements in Section 7 and Appendix A. The risk rating is updated during each full site visit verification. Between verification site visits, the project's reversal risk rating does not change.
10. *A preliminary calculation of the project's Buffer Pool contribution.

In addition to data reported using the project calculation worksheet, the following must be submitted to the Reserve as part of a monitoring report.

For each Reporting Period:

1. A description of how the project meets (or will meet) the definition of Natural Forest Management (refer to Section 3.11.2), including progress on criteria that have not been fully met in previous years.

Conditional reporting, as pertinent:

1. *An explanation for any decrease over any ten-year consecutive period in the standing live carbon pool.
2. Any changes in the status of the Project Operator including, if applicable per Section 3.11.1, the acquisition of new forest landholdings.
3. If a reversal has occurred during the previous year, the report must provide a written description and explanation of the reversal, whether the Reserve classified the reversal as Avoidable or Unavoidable, and the status of compensation for the reversal.

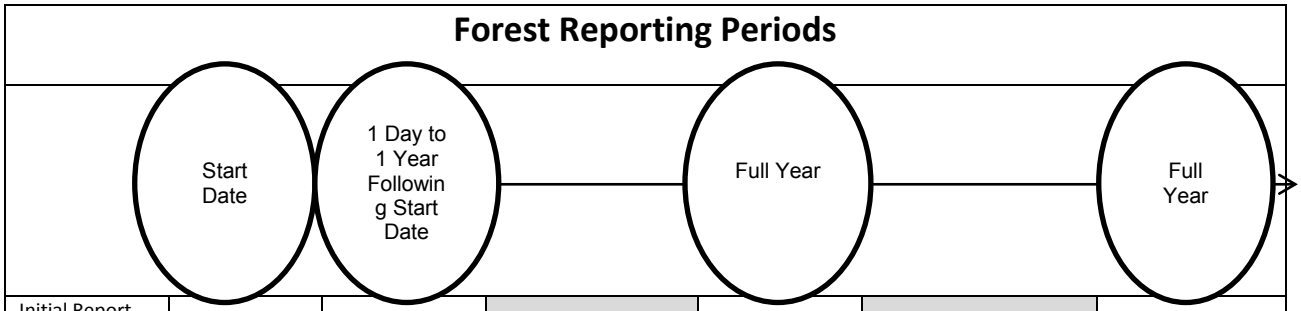
## 8.3 Reporting and Verification Cycle

A Forest Project is considered automatically terminated (see Section 3.4) if the Project Operator chooses not to report data and undergo verification at required intervals.

### 8.3.1 Reporting Period Duration and Cycle

A Reporting Period is a discrete period of time for which a Project Operator quantifies and reports GHG reductions and removals, as well as required project data to the Reserve. The "initial report" or "start date" Reporting Period reports only project data on the project start date. Reporting Periods subsequent to the "initial report" must cover 12 months of project activity, with the exception of the second Reporting Period which may cover up to 12 months in order for the Project Operator to establish a logical reporting date. Harvested Wood Products should not be reported in the "initial report." No CRTs are issued until the second Reporting Period. Figure 8.1 displays the Reporting Periods in graphical form.

Reporting Periods must be contiguous, i.e. there must be no gaps in reporting during the crediting period of a Forest Project once the first reporting period has commenced.




| | | | | | | |
|---|---|---|---|---|---|---|
| Initial Report (for start date)/ Reporting Period | 1 | 2 | | 3 | | 4 |
| Time from last report date: | NA | As desired to establish a reporting cycle | | 1 year | | 1 year |
| **Reported Data** | | | | | | |
| Project Onsite Carbon Stocks | Yes | Yes | | Yes | | Yes |
| Confidence Deduction | Yes | Yes | | Yes | | Yes |
| Project Harvested Wood and Wood Products | No | Yes | | Yes | | Yes |
| CRTs Issued upon Successful Verification? | No | Yes | | Yes | | Yes |

**Figure 8.1.** Forest Project Reporting Periods

### 8.3.2 Verification Cycle

All Forest Projects must be initially verified within 30 months of being submitted to the Reserve. The initial verification of all project types must include a site visit, confirm the project's eligibility, and confirm that the project's initial inventory and the baseline have been established in conformance with the FPP. Subsequent verification may include multiple Reporting Periods and is referred to as the "Verification Period." The end date of any Verification Period must correspond to the end date of a Reporting Period.

Verification may be required or optional. Required verification is established on a temporal framework to ensure that ongoing monitoring of forest carbon stocks, inventory confidence, and risk ratings are accurate and up to date. Optional verification is at the Project Operator's discretion and may be conducted for crediting (non-aggregated projects), to adjust the project's confidence estimate and/or risk ratings, among other rationale, based on changed management circumstances. The schedule of required verification is dependent upon the project type and whether the project is aggregated or non-aggregated. Details of verification scheduling requirements are provided within this section.

Verification must be completed within 12 months of the end of the Reporting Period(s) being verified. For required verifications, failure to complete verification within the 12 month time period will result in account activities being suspended until the verification is complete. The project will terminate if the required verification is not completed within 36 months of the end of the Reporting Period(s) being verified. There is no consequence for failure to complete verification activities within 12 months for optional verifications.

#### 8.3.2.1 Minimum Required Site Visit Verification Schedule

**Non-Aggregated Projects**

Except as allowed for the second verification of Reforestation Projects, the Reserve requires that an approved third-party verification body verify all reported data and information for a Forest Project and conduct a site visit for the Verification Period that coincides with the end of every sixth reporting period following the start date. Site visit verifications are also required any time the Project Operator would like to establish new confidence deductions and/or reversal risk ratings.

For Reforestation Projects, the second verification may be deferred indefinitely beyond end of the sixth reporting period at the discretion of the Project Operator. If deferred, the second verification must be a site visit verification.

**Aggregated Projects**

Site visit verifications must be conducted on a schedule such that at all times a minimum of 50 percent of the projects in the aggregate (rounding up in the case of an uneven number of projects) have successfully completed a site visit verification within the 12-month time allowance for the previous six years of reporting periods, and that 100 percent of the projects have successfully completed a site visit verification within the 12-month time allowed for the previous 12 years of Reporting Periods. These verification requirements are mandatory regardless of the mix of entry dates represented by the group of projects in the aggregate. The initial site visit verification required for entry into the aggregate may count to meet these site verification obligations.

On six-year intervals, beginning with the first year of the existence of the aggregate, the verification body must select from the total group of projects those projects that will have scheduled site visit verifications in order to meet these obligations. The process should utilize random selection to the degree possible and still meet the six- and 12-year completion requirements. For example, in the case where there are ten projects that joined the aggregate in the first year, five of those projects should be chosen randomly and complete a site visit verification within 12 months following the sixth reporting period. The site visit verifications may be spread out through each six-year interval or scheduled in a more concentrated manner that

economizes on verification expenses. Project Operators may be notified of a site visit verification prior to the year in which the verification is to take place.

The only exception is when a second site visit verification for a Reforestation Project is deferred for more than six reporting periods (see Section 6.1.1). In this case, the calculation of the percentages for meeting the six-year and 12-year minimums may be made by excluding the deferred Reforestation Projects from the totals. After the second site visit verification for a Reforestation Project, this exception is no longer allowed.

#### 8.3.2.2 Desk Review Verification

**Non-Aggregated Projects**

In between site visit verifications, the Project Operator may choose to have an approved third-party verification body conduct a desk review of annual monitoring reports as an optional verification. CRTs may be issued for GHG reductions/removals verified through such desk reviews. Adjustments may be made to inventory confidence deductions and/or risk ratings as part of the optional verification.

Submission of annual monitoring reports to the Reserve is required even if the Project Operator chooses to forego desk review verification.

**Aggregated Projects**

Between site visit verifications, each Project Operator must submit annual project monitoring reports. Verification bodies must annually audit a sample of the annual monitoring reports, equivalent to the square root of the total number of participating projects in the aggregate, or the total number of participating projects divided by 12, whichever is higher (when rounded to the next highest whole number). As an example, an aggregate with 16 projects must have four project monitoring reports verified in a given year. Audited projects must be selected randomly, and must not include projects undergoing site visit verification for the year. Project Operators will not know when their annual monitoring reports will require verification. Since this is a random process, a Project Operator may have the annual report verified in consecutive years or when the project is verified with a required site visit.

Successful verification of a representative sample results in the crediting of all projects participating in the entire aggregate. If verification for a participating project is unsuccessful, the verification body must verify additional participating projects until the total number of successful verifications reaches the required number (as described above). If the required number of successful verifications has not been achieved within 12 months after the date the verification body submits a negative Verification Statement and Report to the Reserve for a project in the aggregate, crediting of all the participant projects in the aggregate will be suspended until the required number of successful verifications has been achieved. If material issues arise during verification of a participant project, the Project Operator will need to independently address the issues and required corrective actions using the same process taken with standalone projects.

The Reserve will not issue CRTs for a project in an aggregate that has an unsuccessful verification. As with other projects, if the project is not successfully verified within 12 months, the project account is suspended. If a participating project is not successfully verified within 36 months of a negative Verification Statement, the project will be automatically terminated.

Aggregators may assist the Project Operator in preparing documents for verification and facilitate the verification process. The scope of these services is determined by the specific contract between the Project Operator and the Aggregator. The ultimate responsibility for monitoring reports and verification compliance is assigned to each participating Project Operator.

Desk review verifications are not permitted for Reforestation Projects between the initial and second site visit verifications if the Project Operator has opted to defer the second verification.

### 8.3.3 Issuance and Vintage of CRTs

The Reserve will issue Climate Reserve Tonnes (CRTs) for quantified GHG reductions and removals that have been verified through either site visits, desk reviews, or in an aggregate through the aggregated method of site visits and desk reviews described above. A site visit verification may determine that earlier desk reviews overestimated onsite carbon stocks. Any resulting downward adjustment to carbon stock estimates will be treated as a reversal (see Section 7.1). In this case, the Project Operator must retire CRTs in accordance with the requirements for compensating for a reversal (Section 7.3).

Reforestation Projects for which an initial inventory is deferred are not eligible to receive CRTs until after the second site visit verification.

Vintages are assigned to CRTs based on the proportion of days in each calendar year within a reporting period.

## 8.4 Record Keeping

For purposes of independent verification and historical documentation, Project Operators are required to keep all documents and forms related to the project for a minimum of 100 years after the final issuance of CRTs from the Reserve. This information may be requested by the verification body or the Reserve at any time.

## 8.5 Transparency

The Reserve requires data transparency for all Forest Projects, including data that displays current carbon stocks, reversals, and verified GHG reductions and removals. For this reason, all non-confidential project data reported to the Reserve will be publicly available on the Reserve's website.

# 9 Verification Guidance

This section provides guidance to Reserve-approved verification bodies for verifying GHG emission reductions associated with a planned set of activities to remove, reduce or prevent $CO_2$ emissions in the atmosphere by conserving and/or increasing forest carbon stocks.

This section supplements the Reserve's Verification Program Manual,[18] which provides verification bodies with the general requirements for a standardized approach for independent and rigorous verification of GHG emission reductions and removals. The Verification Program Manual outlines the verification process, requirements for conducting verification, conflict of interest and confidentiality provisions, core verification activities, content of the verification report, and dispute resolution processes. In addition, the Verification Program Manual explains the basic verification principles of ISO 14064-3:2006 which must be adhered to by the verification body.

Forest Project verification bodies must read and be familiar with the following International Organization for Standardization (ISO) and Reserve documents and reporting tools:

1. Forest Project Protocol (this document)
2. Reserve Program Manual
3. Reserve Verification Program Manual
4. Reserve software
5. ISO 14064-3:2006 Principles and Requirements for Verifying GHG Inventories and Projects

Only Reserve-approved Forest Project verification bodies are eligible to verify Forest Project reports. To become a recognized Forest Project verifier, verification bodies must become accredited under ISO 14065. Information on the accreditation process can be found on the Reserve website at http://www.climateactionreserve.org/how/verification/how-to-become-a-verifier/.

The verification of reports that reference carbon stocks must be conducted with the oversight of a Professional Forester, for jurisdictions with a Professional Forester law or regulation, or a Certified Forester,[19] managed by the Society of American Foresters, so that professional standards and project quality are maintained. Any Professional Forester or Certified Forester verifying a project in an unfamiliar jurisdiction must consult with a Professional Forester or Certified Forester practicing forestry in that jurisdiction to understand all laws and regulations that govern forest practice within the jurisdiction. The Reserve may evaluate and approve alternative certification credentials if requested, but only for jurisdictions where professional forester laws or regulations do not exist.

## 9.1 Standard of Verification

The Reserve's standard of verification for Forest Projects is the Forest Project Protocol (FPP), the Reserve Program Manual, and the Reserve Verification Program Manual. To verify a land owner's initial Forest Project Design Document and annual monitoring reports, verification bodies apply the verification guidance in the Reserve's Verification Program Manual and this

[18] Found on the Reserve website at http://www.climateactionreserve.org/how/program/program-manual/.
[19] See www.certifiedforester.org.

section of the FPP to the requirements and guidance described in Sections 2 through 8 of the FPP.

This section of the protocol provides requirements and guidance for the verification of projects associated with the three Forest Project types defined in Section 2, i.e., Reforestation Projects, Improved Forest Management Projects, and Avoided Conversion Projects. All three project types involve planned activities that result in conserving and/or increasing forest carbon stocks. This section describes the core verification activities and criteria for each of the three Forest Project types that are necessary for a verification body to provide a reasonable level of assurance that the GHG removals or reductions quantified and reported by Project Operators are materially correct.

Verification bodies will use the criteria in this section to determine if there exists reasonable assurance that the data submitted on behalf of the Project Operator to the Reserve addresses each requirement in the FPP, Sections 2 through 8. Project reporting is deemed accurate and correct if the Project Operator is in compliance with the Section 2 through 8.

Further information about the Reserve's principles of verification, levels of assurance, and materiality thresholds can be found in the Reserve's Verification Program Manual at http://www.climateactionreserve.org/how/program/program-manual/.

## 9.2 Emission Sources, Sinks, and Reservoirs

For all verification activities, verification bodies review a project's reported sources, sinks, and reservoirs to ensure that all are identified properly and to confirm their completeness. Table 5.1, Table 5.2, and Table 5.3 in Section 5 provide comprehensive lists of all GHG sources, sinks, and reservoirs that must be included in the quantification and reporting of GHG reductions and removals for the three Forest Project types.

It is the Project Operator's responsibility to ensure that verifications are conducted according to the minimum required schedule specified in Section 8.3.2. A Verification Report, List of Findings, and Verification Statement must be submitted within six months of the end of any verification period. Site visit verification requirements are described in Section 9.3.2. Desk review verification requirements are described in Section 9.3.3.

## 9.3 Project Verification Activities

Required verification activities for Forest Projects will depend on whether the verification body is conducting an initial verification for registration on the Reserve, a minimum required verification involving a site visit, or an optional annual verification involving a desk review. Both the initial verification and ongoing verifications must include review of the criteria for Natural Forest Management, inventory of onsite carbon stocks, assessment of carbon in harvested wood products, and review of reversal risk ratings. The following sections contain guidance for all of these verification activities.

### 9.3.1 Initial Verification

Initial verification includes verification that the Forest Project has met the FPP criteria and requirements for eligibility, Project Area definition, modeling baseline onsite carbon stocks, and calculating baseline carbon in harvested wood products. The initial verification must include a site visit. The verification body must assess and ensure the completeness and accuracy of all required reporting elements for the Forest Project Design Document (Section 8.1.1). Initial verification items are presented in Table 9.1A through 9.1K.

*At a Forest Project's initial verification, these items must be verified in addition to all the items required for a standard site visit verification, as detailed in Section 9.3.2.*

#### 9.3.1.1 Initial Eligibility

Verification bodies are required to affirm the project's eligibility according to the rules in this protocol. Tables 9.1A, 9.1B, and 9.1C provide the initial verification items concerning eligibility for the three different Forest Project types and include references to sections of this protocol where requirements are further specified.

**Table 9.1A.** Initial Eligibility Verification Items – Reforestation Projects

| Verification Items | | Supporting Documentation /Review Process | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|---|
| **1. Project Definition** | a. Evidence exists of canopy cover < 10% for 10 years, or<br><br>b. Evidence of significant disturbance provided.<br><br>c. Project has demonstrated no consideration of commercial activities.<br><br>d. No evidence exists for use of broadcast fertilization. | Addressed in PDD | 2.1.1 | Yes |
| **2. Legal Requirement Test** | Proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve. | Consultation with Reserve | 3.1.1.1 | No |
| **3. Performance Test** | a. Reforestation Project that meets 1.a, or<br><br>b. Meets 1.b and shows that the Forest Project corresponds to an "eligible" scenario in Appendix B, or<br><br>c. Shows that the project occurs on a type of land for which the Project Operator has not historically engaged in or allowed timber harvesting. | Addressed in PDD | 3.1.2.1, Appendix B | Yes (for 3.c) |
| **4. Start Date** | Identification of the date on which tree planting occurred or will occur, site preparation for the planting of trees occurred or will occur, or removal of impediments to natural regeneration occurred or will occur (whichever was or will occur first). | Addressed in PDD | 3.2 | No |
| **5. Project Implementation Agreement** | Proof that a Project Implementation Agreement (PIA) between the Project Operator and the Reserve has been signed and recorded in the county of interest. | Consultation with Reserve | 3.5 | No |

| | | | | |
|---|---|---|---|---|
| **6. Project Location** | a. Project is located in the United States of America.<br><br>b. Project is on private land, or<br><br>c. If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or<br><br>d. If tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities. | Address in PDD | 3.8 | No |

**Table 9.1B.** Initial Eligibility Verification Items – Improved Forest Management Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Project Definition** | a. Evidence is provided indicating the canopy cover exceeds 10%.<br><br>b. No evidence exists for use of broadcast fertilization. | 2.1.2 | Yes (for 1.b) |
| **2. Legal Requirement Test** | Proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve. | 3.1.1.2 | No |
| **3. Start Date** | Identification of a discrete, verifiable action that delineates a change in practice relative to the project's baseline. | 3.2 | No |
| **4. Project Implementation Agreement** | Proof that a Project Implementation Agreement (PIA) between the Project Operator and the Reserve has been signed and recorded in the county of interest. | 3.5 | No |
| **5. Project Location** | a. Project is located in the United States of America.<br><br>b. Project is on private land, or<br><br>c. If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or<br><br>d. If tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities. | 3.8 | No |

**Table 9.1C.** Initial Eligibility Verification Items – Avoided Conversion Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Project Definition** | a. Proof that the project is/was on private land prior to project initiation.<br><br>b. Proof that a qualified conservation easement was recorded, or the land was transferred to public ownership.<br><br>c. Demonstration that conversion out of forest is a significant risk (following the requirements of Section 6.3.1 – see also Table 9.1H).<br><br>d. No evidence exists for use of broadcast fertilization. | 2.1.3, 6.3.1 | Yes (for 1.c and 1.d) |
| **2. Legal Requirement Test** | a. Proof that a signed Attestation of Voluntary Implementation form is on file with the Reserve.<br><br>b. Documentation has been provided that demonstrates that the type of land use conversion anticipated by the project is legally permissible; documentation must fall into at least one of the three categories specified in Section 3.1.1.3. | 3.1.1.3 | No |
| **3. Performance Test** | Copy of real estate appraisal for the Project Area indicating conformance to criteria in Section 3.1.2.3. | 3.1.2.3 | No |
| **4. Start Date** | Identification of date on which a conservation easement that dedicates the Project Area to continuous forest cover was recorded or the Project Area was transferred to public ownership. | 3.2, 3.6 | No |
| **5. Project Implementation Agreement** | Proof that a Project Implementation Agreement (PIA) between the Project Operator and the Reserve has been signed and recorded in the county of interest. | 3.5 | No |
| **6. Project Location** | a. Project is located in the United States of America.<br><br>b. Project is on private land, or<br><br>c. If non-federal public lands, provide documentation showing approval by the government agency or agencies responsible, or<br><br>d. If tribal land, provide documentation that demonstrates that the land within the Project Area is owned by a tribe or private entities. | 3.8 | No |

### 9.3.1.2 Project Area Definition

Verification bodies are required to review the geographic boundaries defining the Project Area and their compliance with the requirements outlined in Section 4 of this protocol. These items are verified only at the project's initiation.

**Table 9.1D.** Project Area Definition Verification Items

| Project Type | Verification Items | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. All** | Proof that a description, shapefile, and maps of the geographic boundaries defining the Project Area are on file at the Reserve. For Reforestation projects, the initial Project Area may be provisional until the second site visit verification in cases where the inventory has been deferred. | 4, 8.1 | No |
| **2. Avoided Conversion** | Project Area has been defined following the guidance in Section 4, Table 4.1 for the appropriate conversion type. | 4 | No |

### 9.3.1.3 Modeling Baseline Onsite Carbon Stocks

Verification bodies are required to confirm that the Project Operator has developed a baseline characterization for onsite carbon stocks according to the requirements in this protocol. These items are verified only at the project's initiation.

**Table 9.1E.** Baseline Modeling Verification Items – Reforestation Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Qualitative Characterization** | Clear qualitative characterization of vegetative conditions and activities that would have occurred without the project. | 6.1.1 | Yes |
| **2. Inventory of Onsite Carbon Stocks** | a. An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and the Quantification Guidance (see Section 9.3.5 for further verification guidance).<br><br>b. The inventory of carbon stocks has been deferred until the second site visit verification. | 6.1.1, Quantification Guidance | Yes |
| **3. Baseline Carbon Stock Modeling** | a. A computer simulation has been conducted that models the carbon stocks in accordance with the requirements and guidance in Section 6.1.1 and the Quantification Guidance (see Section 9.3.7 for further verification guidance), or<br><br>b. The computer simulation has been deferred until the project's second site visit verification. | 6, 6.1.1, Quantification Guidance | Yes |
| **4. Description of Forest Project Activities** | A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline. | 2 | No |

**Table 9.1F.** Baseline Modeling Verification Items – Improved Forest Management Projects – Private Lands

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Inventory of Onsite Carbon Stocks** | An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and the Quantification Guidance (see Section 9.3.5 for further verification guidance). | 6.2.1, Quantification Guidance | Yes |
| **2. Compare Initial Above-Ground Standing Live Carbon Stocks with the Minimum Baseline Level** | a. The baseline analysis utilizes the correct value for Common Practice and the Minimum Baseline Level (for above-ground standing live carbon stocks) associated with the Assessment Area(s) covered the Project Area.<br><br>b. Initial above-ground standing live carbon stocks have been estimated correctly following the requirements and the Quantification Guidance. | 6.2.1, Determining Common Practice on the Assessment Area Data webpage, Quantification Guidance | No |
| **3. Baseline Carbon Stock Modeling** | A 100-year forest management simulation of standing live carbon stocks has been conducted in accordance with the requirements and guidance in Section 6.2.1 and the Quantification Guidance (see Section 9.3.7 for further verification guidance). | 6.2.1, Quantification Guidance | Yes |
| **4. Description of Forest Project Activities** | A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline. | 2 | No |

**Table 9.1G.** Baseline Modeling Verification Items – Improved Forest Management Projects – Public Lands

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Initial Forest Carbon Stock Inventory** | An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and the Quantification Guidance (see Section 9.3.5 for further verification guidance). | 6.2.2, Quantification Guidance | Yes |
| **2. Baseline Carbon Stock Modeling** | A 100-year forest management simulation of standing live carbon stocks has been conducted per the requirements in Section 6.2.2 and the Quantification Guidance (see Section 9.3.7 for further verification guidance). | 6.2.2, Quantification Guidance | Yes |
| **3. Description of Forest Project Activities** | A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline. | 2 | No |

**Table 9.1H.** Baseline Modeling Verification Items – Avoided Conversion Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Initial Forest Carbon Stock Inventory** | An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements and the Quantification Guidance (see Section 9.3.5 for further verification guidance). | 6.3.1, Quantification Guidance | Yes |
| **2. Baseline Carbon Stock Modeling** | a. An alternative highest-value land use for the Project Area has been clearly identified by the required appraisal.<br><br>b. The rate of conversion and removal of onsite forest carbon stocks has been appropriately estimated in accordance with the requirements of Section 6.3.1, Step 1.<br><br>c. A 100-year forest management simulation of standing live carbon stocks has been conducted per the requirements in Section 6.3.1, Step 1, and the Quantification Guidance (see Section 9.3.7 for further verification guidance). | 3.1.2.3, 6.3.1 | Yes |
| **3. Discount for the Uncertainty of Conversion Probability** | The Avoided Conversion Discount factor has been correctly calculated per Equation 6.6 in Section 6.3.1, Step 2. | 3.1.2.3, 6.3.1 | No |
| **4. Description of Forest Project Activities** | A description has been provided of the management activities that will lead to increased carbon stocks in the Project Area compared to the baseline. | 2 | No |

### 9.3.1.4 Calculating Baseline Carbon in Harvested Wood Products

Verification bodies are required to confirm that the Project Operator has developed a baseline characterization for carbon in harvested wood products according to the requirements of this protocol and requirements and guidance in Section 6.2.1, Section 6.2.2, or Section 6.3.2, and the Quantification Guidance.

**Table 9.1I.** Baseline Carbon in Wood Products Verification Items – Reforestation Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Baseline Harvest Volume** | If harvesting of any pre-existing trees would be expected to occur in the baseline, the *average* volume of harvesting in each year of the baseline over 100 years has been determined per the requirements and guidance in Section 6.1.2, the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.1.2, Quantification Guidance | No |
| **2. Long-Term Storage in Wood Products** | The average amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and | 6.1.2, Quantification Guidance | No |

| | | | |
|---|---|---|---|
| | guidance of Section 6.1.2 and the Quantification Guidance (see Section 9.3.8 for further verification guidance). | | |

**Table 9.1J.** Baseline Carbon in Wood Products Verification Items – Improved Forest Management Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Baseline Harvest Volume** | The *average* volume of harvesting in each year of the baseline over 100 years has been derived from the growth and harvesting regime used to develop the baseline for onsite carbon stocks, following the requirements and guidance in Section 6.2.1 or 6.2.2, Section 6.2.3, the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.2.1, 6.2.2, 6.2.3, Quantification Guidance | No |
| **2. Long-Term Storage in Wood Products** | The average amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and guidance of Section 6.2.3 and the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.2.3, Quantification Guidance | No |

**Table 9.1K.** Baseline Carbon in Wood Products Verification Items – Avoided Conversion Projects

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Baseline Harvest Volume** | The volume of harvesting in each year of the baseline over 100 years has been derived from the harvesting regime assumed for the baseline for onsite carbon stocks, following the requirements and guidance in Section 6.3.2, the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.3.2, Quantification Guidance | No |
| **2. Long-Term Storage in Wood Products** | The amount of harvested wood that would be delivered to mills in each year has been determined, and the amount of carbon expected to be transferred to wood products each year and stored over the long-term (100 years) has been calculated following the requirements and guidance of Section 6.3.2 and the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.3.2, Quantification Guidance | No |

### 9.3.2 Site Visit Verification

Site visit verification involves review of the Forest Project's carbon stock inventory estimates, relevant attestations, soil carbon emissions associated with management activities, risk of reversal ratings, and compliance with Natural Forest Management criteria. After a Forest Project's initial verification, subsequent site visits must assess and ensure accuracy in measurement and monitoring techniques and onsite record keeping practices.

**Table 9.2.** Site Visit Verification Items

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Attestation of Title** | Proof that a signed Attestation of Title is on file at the Reserve for the dates of the verification period. In addition to reviewing this form, the verification body must conduct a review to confirm ownership and claims to GHG reductions/removals that have occurred over the verification period. | 3.7 | Yes |
| **2. Regulatory Compliance** | Proof that a signed Attestation of Regulatory Compliance form is on file with the Reserve for the reporting period. In addition to reviewing this form, the verification body must perform a risk-based assessment to confirm the statements made by the Project Operator in the Attestation of Regulatory Compliance form. | 3.9 | Yes |
| **3. Sustainable Harvesting Practices** | a. Commercial harvesting is neither planned nor ongoing within the Project Area, or<br><br>b. At the time commercial harvesting is either planned or initiated within the Project Area, the Project Operator meets sustainable harvest practices on all of its landholdings, as described in Section 3.10.1. | 3.11.1 | No |
| **4. Change in Project Operator Landholdings** | If the Project Operator has acquired additional forestlands outside of the Project Area, the Project Operator must incorporate the newly acquired land in their demonstration of sustainable long-term harvesting practices within 5 years of the acquisition. | 3.11.1 | No |
| **5. Maintenance of Standing Live Carbon Pool** | No decrease has occurred in the Project Area's standing live carbon stocks over any ten-year consecutive period not accounted for by allowable exceptions. | 3.11.3 | No |
| **6. Natural Forest Management** | Natural Forest Management eligibility criteria in Section 3.10.2 have been and continue to be met (see Section 9.3.4 for further verification guidance). | 3.11.2 | Yes |
| **7. Estimates of Actual Onsite Carbon Stocks** | a. An inventory of the Project Area's carbon stocks in required and optional pools has been conducted in accordance with the requirements in Section 6 and the requirements and guidance in the Quantification Guidance (see Section 9.3.5 for further verification guidance), or<br><br>b. Inventory has been deferred until the second site visit verification for Reforestation Projects. | 6.1.3, 6.2.4, 6.3.2, Quantification Guidance | Yes |
| **8. Estimates of Actual Carbon in Harvested Wood Products** | The amount of harvested wood that has been delivered to mills over the reporting period has been determined correctly, and the amount of carbon expected to be transferred to wood products and stored over the long-term (100 years) has been calculated correctly, per the requirements in Section 6 and the requirements | 6.1.4, 6.2.5, 6.3.4, Quantification Guidance | No |

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| | and the Quantification Guidance (see Section 9.3.8 for further verification guidance). | | |
| **9. Quantification of Primary Effect** | Calculations for the Primary Effect are complete and accurate for both onsite carbon stocks and harvested wood products. | 6 | No |
| **10. Quantification of Secondary Effects** | Calculations for quantifying Secondary Effects are complete and accurate. | 6.1.5, 6.2.6, 6.3.5 | No |
| **11. Reversal Determination** | If a reversal has occurred, the type of reversal (avoidable or unavoidable) has been properly identified. | 7.3 | Yes |
| **12. Reversal Risk Rating** | Project's risk rating has been calculated following the requirements of Appendix A | Appendix A | No |

*For Reforestation and Avoided Conversion projects, a signed Attestation of Voluntary Implementation is only required at the project's initial verification, as a condition for registration (Tables 9.1A and 9.1C, above).

### 9.3.3 Desk Review Verification

For reporting periods in between required site visits, project verification activities may consist of a desk review. During a desk review, the verification body will review the data in annual monitoring reports to check calculations and information for reasonability, accuracy, and completeness.

**Table 9.3.** Desk Review Verification Items

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Attestation of Title** | Proof that a signed Attestation of Title is on file at the Reserve for the dates of the verification period. In addition to reviewing this form, the verification body must conduct a review to confirm ownership and claims to GHG reductions/removals that have occurred over the verification period. | 3.7 | Yes |
| **2. Regulatory Compliance** | Proof that a signed Attestation of Regulatory Compliance form is on file with the Reserve for the reporting period. In addition to reviewing this form, the verification body must perform a risk-based assessment to confirm the statements | 3.9 | Yes |

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| | made by the Project Operator in the Attestation of Regulatory Compliance form. | | |
| **3. Maintenance of Standing Live Carbon Pool** | No decrease has occurred in the Project Area's standing live carbon stocks over any ten-year consecutive period not accounted for by allowable exceptions. | 3.11.3 | No |
| **4. Estimates of Actual Onsite Carbon Stocks** | Reported onsite carbon stocks are within expected bounds given reported harvest, growth, and disturbance effects since the prior reporting period. | 6.1.3, 6.2.4, 6.3.3, Quantification Guidance | Yes |
| **5. Estimates of Actual Carbon in Harvested Wood Products** | The reported amount of wood that has been delivered to mills over the reporting period is consistent with reported harvest levels, and the amount of carbon expected to be transferred to wood products and stored over the long-term (100 years) has been calculated correctly, per the requirements in Section 6 and the requirements and the Quantification Guidance (see Section 9.3.8 for further verification guidance). | 6.1.4, 6.2.5, 6.3.4, Quantification Guidance | Yes |
| **6. Quantification of Primary Effect** | Calculations for the Primary Effect are complete and accurate for both onsite carbon stocks and harvested wood products. | 6 | No |
| **7. Quantification of Secondary Effects** | Calculations for quantifying Secondary Effects are complete and accurate. | 6.1.5, 6.2.6, 6.3.5 | No |
| **8. Reversal Determination** | If a reversal has occurred, the type of reversal (avoidable or unavoidable) has been properly identified. | 7.3 | Yes |
| **9. Reversal Risk Rating** | Reversal risk rating is the same used since the previous site visit verification. | Appendix A | No |

### 9.3.4 Natural Forest Management

All Forest Projects must promote and maintain a diversity of native species and utilize management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple landscape scales (Natural Forest Management).At a Forest Project's first site visit verification and at all subsequent site visit verifications, the verification body must evaluate the project against the Natural Forest Management criteria described in Section 3.11.2,referencing the most current Assessment Area Data File available on the Forest Project Protocol webpage. Forest project carbon stock inventories (requirements for which are contained in the Quantification Guidance) should be used as the basis of these assessments where applicable. Forest projects that do not initially meet Natural Forest Management criteria but can demonstrate progress towards meeting these criteria within the required timelines are eligible to register and maintain that registration with the Reserve.

**Table 9.4.** Natural Forest Management Verification Items

| Verification Items | | Apply Professional Judgment? |
|---|---|---|
| **1. Native Species** | Completed inventory demonstrates that project consists of at least 95% native species. Must demonstrate continuous progress toward goal and criterion must be met within 50 years. | Yes |
| **2. Composition of Native Species** | a. Reforestation Projects: Documentation on planted mixture of species combined with natural regeneration meets composition of native species goals. Project must show continuous progress and criteria must be met within 50 years.<br><br>b. Improved Forest Management and Avoided Conversion Projects: Completed inventory demonstrates standing live carbon meets composition of native species goal. Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved over the project life. | Yes |
| **3. Sustainability of Timber Resource** | a. Documentation showing that the forest, including entity lands outside Project Area, is currently under one of the following:<br>i. Third party certification under the Forest Stewardship Council or Sustainable Forestry Initiative/ Tree Farm System, or<br>ii. A renewable long-term management plan sanctioned and monitored by a state or federal agency within a Reserve-approved Assessment Areas, or<br>iii. For Project Operators and their affiliates that own 5,000 acres or less, uneven-aged silvicultural practices (if harvesting occurs) and canopy retention averaging at least 40% across the entire forestland owned by the Project Operator in the same Assessment Areas covered by the Project Area, as measured on any 20 acres within the Project Operator's landholdings found in any of these Assessment Areas, including land within and outside of the Project Area (areas impacted by Significant Disturbance may be excluded from this test), or<br>iv. Possessing a deeded conservation easement(s) that contain terms that ensure growth equals or exceeds harvest over time.<br><br>b. Completed inventory demonstrates the project maintains, or makes progress toward maintaining, no more than 40% of forested acres in ages less than 20 years. Project must show continuous progress and this criterion must be met within 25 years. | Yes |
| **4. Structural Elements (Lying and Standing Dead Wood)** | Completed inventory work demonstrates that lying and standing dead wood is retained in sufficient quantities and for sufficient duration depending on whether portions of the Project Area have undergone salvage harvesting. | Yes |

### 9.3.5 Verifying Carbon Inventories

Verification bodies are required to verify carbon stock inventory estimates of all sampled carbon pools within the Project Area. Inventories of carbon stocks are used to determine the project baseline and to quantify GHG reductions and removals against the project baseline over time. Verification of carbon inventories consists of ensuring the Project Operator's sampling methodology conforms to requirements listed in the protocol and that the project's inventory sample plots are within specified tolerances when compared to the verifier's sample plots. Verification is effectively an audit to infer that the inventory estimate is sound. Verification of the project's onsite stocks must occur at each site verification and focus on ensuring that the

project's inventory methodology is technically sound and that the methodology has been correctly implemented.

The project must meet the inventory standards in Table 9.6 prior to the verification body initiating field sampling activities. The verifier will install sample plots or re-measure existing monumented sample plots consistent with the objectives of a random, risk-based, and efficient approach.[20] In doing so, the verifier may weigh the probability of selecting strata and plots based on various criteria – including carbon stocking, access difficulty, and vegetation heterogeneity. Verifiers may choose to sample project plots within a given stratum with a cluster design. The selection of a stratum may use probability proportional to carbon stocks or probability proportional to the risk of errors (as hypothesized by the verifier).

#### 9.3.5.1 Sequential Sampling for Verification

As a policy to ensure a trend of agreement with sampled data is sustained between the verifier and Project Operator, Forest Project Protocol Version 3.3 requires a sequential sampling method for verification of project estimates. Sequential sampling is intended to provide an efficient sampling method for verifiers to determine if randomly selected project measurements are within specified tolerance bounds established by the protocol.

Verification using the sequential sampling methodology requires the verification body to sequentially sample successive plots. Sequential approaches have stopping rules rather than fixed sample sizes. Verification is successful after a minimum number of successive plots in a sequence indicate agreement. Where the stopping rules indicate the potential presence of a bias, additional verification plots may be collected after that time if it is felt that random chance may have caused the test to fail and a convergence towards agreement is expected with additional verification samples. The results of any additional verification plot may also be inconclusive and require additional verification plots for a determination to be made. For effective application of the sequential statistics in the field, the determination of when the stopping rule is met is done at the end of each sampling day, which will include the full set of plots measured in that day.

Worksheets are provided for use by verifiers to assist in verifying sampled data. The verifier will review the descriptive statistics of the carbon stocks independently for each pool or combination of pools that is being reported for crediting (applicable pool) as shown below:

- Standing live and dead trees
- Soil

Separate worksheets have been developed to assess both monumented (paired) and non-monumented (unpaired) plots. Worksheets are found on the Forest Project Protocol webpage.

The Reserve has established a ten percent allowance as an acceptable level of agreement between the verifier and the Project Operator, without adjusting the project estimates for uncertainty. The Reserve will accept applying up to a 20 percent allowance, meaning that the

[20] For the purposes of this verification guidance the following terms and definitions apply:

1. Stand: An individual unit or polygon that is relatively homogeneous in terms of the carbon stocking within its borders. For live and dead trees, the determination of stand boundaries is usually based on forest vegetation attributes, such as species, size (age), and density characteristics. For soils, the determination of soil stand boundaries is made on similar soil orders.
2. Stratum: A group of stands that contain a similar attribute, such as vegetation or soils attributes.
3. Strata: Plural of stratum. The set of different groupings for a specific attribute, such as vegetation or soil.

verifier can infer that their estimates indicate an agreement within 20 percent of the Project Operator's estimates, with an adjustment applied to the credits issued to the Project Operator for the higher uncertainty. The rules for determining the adjustment are as follows:

- Where project estimates can be verified within a ten percent allowance level, no adjustment will be applied to the project submission.

  If the project data do not agree with the verifier data at the ten percent allowance level, the allowance level shall be incrementally adjusted upwards by one percent until the data display a stopping rule indicating agreement. Due to the inherent variability present in larger allowance levels, the average value of the project developer's carbon estimates for project sites shall be adjusted proportional to the adjusted allowance level.

- This proportion will be applied to each stratum according to the following Table 9.5.

**Table 9.5.** Adjustment Factors for Associated Allowance Levels

| Passing Allowance Level | Project Site Carbon Average Adjustment Factor |
|---|---|
| 11% | 0.98 |
| 12% | 0.96 |
| 13% | 0.94 |
| 14% | 0.92 |
| 15% | 0.90 |
| 16% | 0.88 |
| 17% | 0.86 |
| 18% | 0.84 |
| 19% | 0.82 |
| 20% | 0.80 |

- If the project's inventory is stratified, the adjustment shall be applied to the entire project estimate by applying the adjustments as a proportion to the project inventory.
- Equation 9.1 below demonstrates how strata level adjustments are to be applied to project inventories.

**Equation 9.1.** Adjustment to Project Inventory Using Strata Level Adjustments

$$\left(\frac{\sum_{i=1}^{n} STRv_i STRvadj_i}{\sum_{i=1}^{n} STRv_i}\right) \times STR_{total}$$

*Where,*

| | | |
|---|---|---|
| n | = | Number of strata verified |
| $STRv_i$ | = | $CO_2e$ in verification stratum *i* |
| $STRvadj_i$ | = | Adjustment factor used from Table 9.5 for verification stratum i |
| $STR_{total}$ | = | Total sum of $CO_2e$ in all project strata |

- If the carbon estimate does not pass the sequential sampling methodology at a 20 percent allowance level for the project or any given stratum, then the carbon for that specific carbon pool shall be considered unverifiable.

### 9.3.5.2 Inventory Estimates

The items in Table 9.6 are measures that need to be taken before the verifier goes to the field and analyzes the plots.

**Table 9.6.** Inventory Methodology Verification Items

| Verification/Evaluation Standards | | Insert a 'Failure to Meet Standard' in any category below where the standards on the left are not met or clearly have not been implemented as described in the inventory methodology |
|---|---|---|
| 1.a | Inventory methodology describes the methodology for plot location in the field. The plot locations are either random or systematic with a random initial point. | X |
| 1.b | If inventory methodology describes a stratification design:<br>The stratification methodology, including rules for stratification, is clearly defined.<br><br>The stratification design is relevant for the sampling of biomass. In particular, the stratification design applies to all tree species without a bias for commercial tree species.<br><br>Verifier shall randomly select 10% of the vegetation units, or strata polygons, by area, or 500 acres (whichever is least) to evaluate that the vegetation (or stratum) label assigned to the polygon is consistent with the stratification rules documented in the inventory methodology. The selection shall be made from a database or spreadsheet list of all vegetation (stratum) polygons within the project that have not experienced a harvest or disturbance that affects carbon stocks by more than 10%, using verifier judgment, within the past 10 years. Evaluation of post-harvest polygons and plots is described in 1.c.<br><br>Evaluation for consistency shall be conducted through comparison with aerial photos or other remotely sensed data, and/or field observation. During evaluation, a verifier must use professional judgment to determine if a polygon is consistent or inconsistent with the stratification rules. Inconsistent means the existing vegetation (stratum) label is grossly incorrect to an extent that would substantially alter the associated carbon stocks.<br><br>If more than 10% of the polygons evaluated are determined to be inconsistent with the stratification rules documented in the inventory methodology, the verification shall expand the assessment to an additional 10% of the vegetation units (stratum polygons), or an additional 500 acres (whichever is least) and expand the analysis, or determine that the project has failed to meet the standard. | X |
| 1.c | Inventory methodology states how the inventory is updated on an annual basis to reflect growth, harvest, and other disturbances. An event is deemed to be a disturbance, whether natural or the result of human activities, if the event results in an estimated loss of more than 10% of the pre-disturbance carbon stocks in the applicable carbon pools. The methodology includes a process to:<br><br>1. Update the inventory for harvest and other disturbances. The immediate updating of an inventory for disturbances will require that a tree list is assigned to the area disturbed, rather than developing a tree list from field measurements, to represent the area disturbed. This may occur by assigning a vegetation label (stratifying) and compiling the inventory so | X |

| | | |
|---|---|---|
| | that the area disturbed obtains a tree list representative of the disturbed condition. For stratified inventories, this may be a solution that lasts many years until the forest vegetation is re-stratified due to changes from forest growth. Immediately updating an inventory may also occur by assigning a 'best-fit' tree list that represents the stand conditions to the plots that were affected by disturbance. This solution is a shorter term solution since the plots used to estimate the inventory have been affected.<br><br>During all site visit verifications (following the initial site visit verification in cases where the project start date is the same year as the initial site visit verification),the Project Operator must provide a map(s) that displays areas where disturbance has occurred. For stratified inventories, a pre-disturbance map must display the vegetation stratum prior to the disturbance and a post-disturbance map must display the vegetation stratum following the disturbance. For non-stratified inventories, the disturbance map must display the underlying plots, if any, affected by the disturbance. For stratified inventories, a summary tree list associated with the updated vegetation strata shall be provided. For non-stratified inventories, tree lists shall be provided for each plot affected by disturbance.<br><br>During site verification, verifiers shall randomly select a minimum of 10% of the vegetation polygons (strata polygons) or plots updated for disturbance, and determine if the assigned tree lists do not obviously overestimate the carbon associated with the forest structure remaining after the disturbance. Where plots are updated through assignment of a tree list (instead of assigning a vegetation stratum) following the disturbance, the verifier shall ensure all plots have been updated and the updated tree list is consistent with the forest structure remaining after disturbance. For non-stratified inventories, it is not acceptable for a Project Operator to simply remove disturbed plots from the inventory. The plots must be assigned a tree list to estimate the post-disturbance condition. It is acceptable to remove plots from an inventory that is strata-based upon disturbance that affects the plots.<br><br>Tree lists resulting from stratification or assignment are determined to be inconsistent if the tree list would result in carbon stocks substantially above what in the verifier's professional judgment would associate with the post-disturbance condition. The determination for consistency can be made through an office review by comparing the assigned tree lists with the disturbance events. A verifier can choose to enhance their review for consistency by visiting disturbed sites in the field.<br><br>To minimize the risk of inaccuracies to the inventory, no more than 10% of the plots used to characterize the project's inventory can be developed from estimated tree lists without increased scrutiny from verification. The plots assigned an estimated tree list must be appropriately coded in the inventory database so that they can be queried and isolated. Plots assigned with an estimated tree list are not to be used in sequential sampling efforts unless the number of plots with estimated tree lists exceeds 10%, in which case all plots, measured or estimated, must be available for random selection for sequential sampling during verification.<br><br>1. Update the inventory for growth using and approved growth model or a stand table projection, as described in the Quantification Guidance. | |

| | | |
|---|---|---|
| | The inventory being verified is determined to be current using the update methodology. | |
| 1.d | The inventory methodology has been implemented in a consistent manner since the project's inception.<br><br>If changes have been made to the inventory methodology, such changes have been discussed and approved in writing by the Reserve. | X |
| 1.e | The inventory methodology describes the volume and biomass equations used to compute the project's carbon stocks and these equations are consistent with those required by the protocol. Appropriate use of biomass equations is demonstrated. | X |

Each applicable pool/combination of pools must meet the minimum precision threshold stated in the Forest Project Protocol of +/- 20 percent at the 90 percent confidence interval. Project Operators can improve the precision of their estimates through additional inventory effort, but can only include it in their reporting after the confidence estimate has been verified. Projects must include the uncertainty adjustment associated with their most recent verification effort. The emissions associated with site preparation activities (soil, shrubs, and herbaceous understory) are not subject to the same sequential sampling requirements and shall be verified according to the guidance for estimating site preparation emissions for reforestation projects in the online Quantification Guidance.

The level of field review during the verification of the project's onsite stocks is based on the programmatic risk (risk of inaccuracy to the entire forest offset program) and project risk (risk of inaccuracies at the project level). Small projects with low levels of reported reductions/removals are verified with a smaller number of plots than large projects with high levels of reported reductions/removals. All projects must be within the maximum acceptable error of ten percent (verifier estimates compared to project estimates).

### 9.3.5.3 Measurement Specifics for Verifiers

Verifiers must use the highest standard to conduct measurements during field measurements. Measurements utilized by verifiers during field inspections shall be consistent with the tolerance standards for measurements identified in the Quantification Guidance, with the following exceptions:

1. Verifiers shall measure the heights of all trees according to the height measurement used for the species-specific biomass equation on the Reserve's Forest Project Protocol webpage, under Protocol Companion Documents and Tools.
2. The use of regressions to estimate heights is allowable for Forest Operators; verifiers should measure each height for comparisons with Forest Operator's estimates.
3. Tools and methods used for distance measurements for plot boundaries should be accurate within 1"/30'.
4. Tools and methods used for distance measurements for height measurements must be able to obtain an accuracy of 6"/100'.
5. All borderline tree should be measured to determine their status as an 'in' or 'out' tree.

### 9.3.5.4 Verifying a Stratified Inventory

Where the Project Operator's inventory is stratified, the strata to be verified may be selected by the verifier according to the presumed risk of measurement error or presumed risk of the effects of measurement error on the overall inventory estimate, as described above. Individual stands

and/or plots must be independently selected using a random selection design. The verifier shall select three strata (or the maximum number of strata present) based on the verifier's evaluation of risk. The minimum number of passing plots varies by project size and number of strata verified (Table 9.7).

### 9.3.5.5 Verifying a Non-Stratified Inventory

If the project is not stratified for each applicable pool, the verifier shall select the plots randomly (if plot locations can be relocated) or allocate the plots systematically or in clusters for efficiency. Where plots can be relocated, the plots available for selection shall adhere to the guidance in Table 9.6 (1.c) with regards to updating inventories based on disturbance events. If the verifier uses a cluster design as part of the systematic allocation of plots, the mean of the cluster accounts for one observation (plot). Plots may be measured and assessed one at a time or in reasonable batches that correspond to logistical realities such as crew-days of effort.

### 9.3.5.6 Verification Within a Stand

Plots or clusters must also be independently selected using a random or systematic design. No more than six plots or clusters can be assigned to a stand, unless the groups of plots required for verification exceed the number of stands that exist for the project.

**Table 9.7.** Number of Passing Plots in Sequence, as a Function of Project Size

| Test | Number of Strata Verified | Project Acres | | | | |
|---|---|---|---|---|---|---|
| | | <100 | 100 – 500 | 501 - 5,000 | 5,001 – 10,000 | >10,000 |
| Paired/Unpaired | 3 | 2 | 3 | 4 | 5 | 6 |
| | 2 | 4 | 6 | 8 | 10 | 12 |
| | 1 | 8 | 12 | 16 | 20 | 24 |

There are two possible statistical procedures that can be applied to the stratum-level verifications. A paired test can be applied when plot locations can be found and it is statistically appropriate to use a paired test (i.e. plot measurements can be replicated). An unpaired test can be applied when plots cannot be relocated. The range of acceptable error (δ, delta) is fixed at ten percent for both tests.

**Paired Plots**

The statistical test is based on a comparison of the verifier's measurements of plots within a selected stratum, calculated as $CO_2$-e compared to the Project Operator's measurements of plots, which may include any adjustments for growth.

Use **α=0.05** and **β=0.20** to control for error.

The null hypothesis ($H_0$) is that the verification and project plots are equal.

1) Perform verification sampling on at least the minimum number of passing plots required in a sequence from Table 9.7.

2) If $\mathbf{n \geq ((Z_\alpha + Z_\beta)^2 \times S_n^2) / D^2}$ then stop and evaluate. Otherwise take another sample.

   n = Number of verification plots measured

$Z_\alpha$ = α% N(0,1) = 1.645
$Z_\beta$ = β% N(0,1) = 0.8416
$S_n^2$ = sample variance of the differences
D = δ × project average estimate

3) If stopped, then evaluate.

   If $\bar{X}_N \leq K$ then accept $H_0$,
   If $\bar{X}_N > K$ then reject $H_0$.

$\bar{X}_N$= sample mean of the differences
N = total number of plots measured
K = $(Z_\alpha \times D) / (Z_\alpha + Z_\beta)$.

4) If $H_0$ was rejected then additional samples may be taken as long as the verifier is of the opinion that there is a chance that $H_0$ may be accepted based on the variability and trend observed.

**Unpaired Plots**

The statistical test is based on comparing the average $CO_2$-e estimates for each stratum from the verifier plots to the Project Operator plots.

Use **α=0.05** to control for error; the β is not specified because we are constructing a confidence interval not a test. The null hypothesis ($H_0$) is that the verification and stratum averages are equal. The following procedure is appropriate for the unpaired test.

1) Perform verification sampling on at least the minimum number of plots required in a sequence from Table 9.7. Calculate n as the sum of the number of plots from both the stratum and the verification.

2) Calculate the following:

   $T_n = \bar{X}_P - \bar{X}_n$

   *Where,*
   $\bar{X}_P$ = stratum mean,
   $\bar{X}_{n_n}$ = verification mean after sample n.
   $S_n^2$ = sample variance of the verification plots,
   $S_P^2$ = sample variance of the stratum plots,
   D = δ × stratum average estimate.

3) If $\mathbf{n \geq (a^2/D^2) \times (S_n^2 + S_P^2)}$ then stop and evaluate. (Note: n = n = $n_P + n_V$). Otherwise take another sample.

4) If stopped, then evaluate. Construct a confidence interval $T_n \pm D$.
   If the confidence interval includes zero then accept $H_0$,
   Otherwise reject $H_0$.

5) If $H_0$ was rejected then additional samples may be taken until as long as the verifier is of the opinion that there is a chance that $H_0$ may be accepted based on the variability and trend observed.

If the stopping rule in step (3) above cannot be attained within 100 plots then apply a standard unpaired t-test comparison using alpha of 0.05 and beta of 0.80.

### 9.3.6 Step-by-Step Guidelines for Performing the Verification

**Step1: Assigning Risk to Strata**

The verifier must determine for standing live and standing dead trees if the Project Operator has stratified the Project Area into strata that reflect common characteristics that influence carbon stocks. The verifier may presume risk exists in the highest stocked strata, strata that are unique or difficult to access due to topographical, vegetative, or other physical barrier, strata that represent a large portion of the project's inventory due to the area they represent, or any other risk perceived by the verifier. The determination of risk must be applied to the stratum as a unit and not individual stands of a given stratum.

**Step 2: Selecting Strata Based on Risk**

Based on the assessment of risk, the verifier will query or request that the Project Operator query the set of stands that are associated with the strata selected. The queried stands must have an identifier which can be based on the Project Operator's identification convention or one assigned by the verifier. Three strata must be selected, or the maximum number of strata stratified by the Project Operator for each pool. Table 9.8 displays an example of ordered strata for standing live and dead trees selected by stratum with random numbers assignments.

**Table 9.8.** Stands Selected by Vegetation Strata and Risk Class with Random Number Assignments

| Stand Number | Stratum (from Project Operator or Verifier) | Risk Class | Order of Random Selection |
|---|---|---|---|
| 2 | Dense Intermediate Conifers | High Stocking | 5 |
| 3 | Dense Intermediate Conifers | High Stocking | 3 |
| 4 | Dense Intermediate Conifers | High Stocking | 1 |
| 8 | Dense Intermediate Conifers | High Stocking | 8 |
| 9 | Dense Intermediate Conifers | High Stocking | 2 |
| 10 | Dense Intermediate Conifers | High Stocking | 1 |
| 15 | Dense Intermediate Conifers | High Stocking | 4 |
| 18 | Dense Intermediate Conifers | High Stocking | 7 |
| **Stand Number** | **Stratum (from Project Operator or Verifier)** | **Risk Class** | **Order of Random Selection** |
| 8 | Dense Mature Conifers | High Stocking | 4 |
| 9 | Dense Mature Conifers | High Stocking | 3 |
| 10 | Dense Mature Conifers | High Stocking | 5 |
| 15 | Dense Mature Conifers | High Stocking | 2 |
| 18 | Dense Mature Conifers | High Stocking | 1 |
| **Stand Number** | **Stratum (from Project Operator or Verifier)** | **Risk Class** | **Order of Random Selection** |
| 13 | Medium Dense Mature Riparian | Difficult Access | 2 |
| 14 | Medium Dense Mature Riparian | Difficult Access | 1 |
| 17 | Medium Dense Mature Riparian | Difficult Access | 3 |

**Step 3: Planning and Implementing Field Verification Sampling**

The selected stands should be mapped and labeled with the random number to assist in developing a strategy to perform field sampling activities. Up to six plots or clusters may be re-

measured in a stand (if plots are monumented by the Project Operator) or installed (if plots are not monumented) in each stand. If the Project Area has not been stratified or there are less than three strata, the verifier shall locate the plots or clusters using a random process of their own design. For efficiency, it is acceptable for the verifier to relocate to a new area at the beginning of a day without having completed all the plots in the previous day.

**Step 4: Determining if the Stopping Rules Have Been Met**

The verifier must determine if the stopping rules have been met for each stratum after the measurement of each plot or at a minimum the end of each day. The Reserve provides tools to assist verifiers with determining if the stopping rules have been met or not. The tools are Microsoft Excel based and are distinct for paired designs and for unpaired designs.

The verifier must enter their data into the appropriate spreadsheet based upon use of a paired or unpaired test). It is required that the verifier apply the random order selection in the sampling process. The verifier is free to measure the set of plots that were randomly selected in any order that provides the greatest efficiency while sampling in the field, but when the verifier inputs data into the spreadsheet, the verifier must follow the random selection order in order to properly conduct the analysis and maintain the integrity of sequential analysis. This may provide significant efficiencies when selected stands and/or plots are in close geographic proximity and it is hypothesized that the stopping rules will require the full number of plots. Table 9.9 displays a hypothetical sampling schedule planned by the verifier and the hypothetical verification results. In this case, the sequential sampling is conditionally satisfied after Day 3 but requires the full set of randomly selected stands to be sampled up to the point of satisfying the sequential statistics, which is met after sampling Stand 3 on Day 4.

**Table 9.9.** Example of Randomly Selected Plots

| Stand | Stratum (from Forest Owner) | Risk Class | Order of Random Selection | Sampling Schedule (Planned) | Verification Effort | Verification Results |
|---|---|---|---|---|---|---|
| 4 | Dense Intermediate Conifers | High Stocking | 1 | Day 3 | Day 1 | Inconclusive. Stand 9 sampled. Sequential sampling criteria not satisfied - More plots are needed |
| 9 | Dense Intermediate Conifers | High Stocking | 2 | Day 1 | Day 2 | Inconclusive. Stand 15 sampled. Sequential sampling criteria not satisfied - More plots are needed |
| 3 | Dense Intermediate Conifers | High Stocking | 3 | Day 4 | Day 3 | Inconclusive. Stand 4 sampled. Sequential sampling criteria satisfied but stand order must be satisfied. Stand 3 must be sampled |
| 15 | Dense Intermediate Conifers | High Stocking | 4 | Day 2 | Day 4 | Conclusive. Stand 3 sampled. Sequential sampling criteria is met and adherence to random selection is maintained |
| 2 | Dense Intermediate Conifers | High Stocking | 5 | Day 6 | Further Verification Effort not Necessary | |
| 10 | Dense Intermediate Conifers | High Stocking | 6 | Day 5 | | |
| 18 | Dense Intermediate Conifers | High Stocking | 7 | Day 7 | | |
| 8 | Dense Intermediate Conifers | High Stocking | 8 | Day 8 | | |

Finally, in addition to evaluating and verifying adherence to the Project Operator's inventory methodology, the verification body must verify the items in Table 9.10.

**Table 9.10.** Additional Verification Items for Inventory Methodology and Implementation

| Verification Items | | Apply Professional Judgment? |
|---|---|---|
| **1. Inventory Update Processes** | a. Project Operator's inventory document describes methodology for updating inventory data resulting from growth, harvest, and disturbances. Methodology adheres to acceptable forestry practices.*<br><br>b. Harvest/Disturbance updates in inventory management system are implemented per the specified methodology and are representative of the harvest or disturbance.<br><br>c. Growth is accounted for using an approved growth model or using a stand table projection, as described in the Quantification Guidance. | Yes |

| | | |
|---|---|---|
| **2. Biomass Equations and Calculations** | a. The carbon tonnes per acre for a representative sample plot, computed using the Project Operator's calculation tools, replicate output computed by the verification body.**<br><br>b. All conversions and expansions are accurate. | Yes |

*A forest biometrician employed by the state in which the project is located, or a consulting forest biometrician may be consulted in the event of a dispute between the verification body and Project Operator. The written opinion of the forest biometrician, submitted to the Reserve as part of the verification report, shall be considered the authoritative word.

**The verification body must provide an (idealized) 'verification plot' consisting of all tree species in Project Area with varying heights and diameters existing within the Project Area. The plot need not correspond to an actual plot within the Project Area.

### 9.3.7 Baseline Modeling

To determine a Forest Project's baseline, computer models are used to project the Project Area's initial inventory of carbon stocks into the future under a set of constraints prescribed by this protocol (Section 6). Modeling must include assumptions about forest growth and harvest, as influenced by legal and financial constraints, and assumptions regarding the extent of harvest operations under Business As Usual conditions.

Verification bodies are required to verify the baseline estimate for the project at the initial site visit verification for Improved Forest Management Projects and Avoided Conversion Projects. Reforestation baselines may be verified at the second site visit verification.

Baseline modeling must incorporate initial inventory estimates and forecast how carbon stocks will change over the Forest Project's crediting period.

All reports that reference carbon stocks must be submitted by the Project Operator with the oversight of a Professional Forester. If the project is located in a jurisdiction without a Professional Forester law or regulation, then Certified Forester credentials managed by the Society of American Foresters (see http://www.certifiedforester.org) are required so that professional standards and project quality are maintained.

**Table 9.11.** Baseline Modeling Verification Items

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Document** | A modeling document exists that contains all the verification items in this table. | 9 | No |
| **2. Qualitative Characterization (Reforestation and Avoided Conversion Projects Only)** | A sufficiently detailed qualitative characterization has been included in the modeling document that documents the general assumptions of the project's baseline. The qualitative assessment addresses the vegetative conditions and activities that would have occurred. | 6.1, 6.3 | Yes |

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **3. Model Choice and Calibration** | a. The model used is an approved model.<br><br>b. The Project Operator has provided a rationale for any model calibrations or a sufficient explanation of why calibrations were not incorporated.<br><br>c. The Project Operator has provided a description of the site indexes used for each species and a sufficient explanation of the source of the site index values used. | Quantification Guidance | Yes |
| **4.Legal Constraints** | A list of legal constraints is provided that includes an accurate description of the type and effect of each constraint on the ability to harvest trees and the area constrained. | 3.1.1, 6.1.1, 6.2.1.2, 6.3.1 | Yes |
| **5. Financial Constraints** | a. A sufficient qualitative description is provided indicating that the harvesting activity modeled in the baseline is a financially viable activity.<br><br>b. For Improved Forest Management projects, Project Operator has provided either a financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints; or has provided evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years. | 3.1.2, 6.1.1, 6.2.1.3, 6.3.1, | Yes |
| **6. Silviculture Guidelines** | The silviculture guidelines incorporated in the model demonstrate all legal constraints are applied in the model. The silviculture guidelines must include:<br>i. A description of the trees retained by species group<br>ii. The level of retention<br>iii. Harvest frequency<br>iv. Regeneration assumptions | Quantification Guidance | No |
| **7. Modeling Guidelines** | a. Reforestation: Modeling is based on the qualitative characterization of the baseline and conducted per Section 6.1.<br><br>b. Improved Forest Management: Modeling is conducted per Section 6.2.<br><br>c. Avoided Conversion: Modeling is conducted per Section 6.3. | 6.1, 6.2, 6.3 | No |
| **8. Modeling Outputs** | a. The Project Operator has provided reports that display periodic harvest, inventory, and growth estimates for the entire Project Area presented as total carbon tonnes and carbon tonnes per acre.<br><br>b. Estimates are within the range of expected growth patterns for the Project Area. | 9, Quantification Guidance | Yes |

### 9.3.8 Verifying Estimates of Carbon in Harvested Wood Products

Verification bodies are required to verify the estimates of carbon that are likely to remain stored in wood products over a 100-year period, as submitted in the Forest Project Design Document (for baseline estimates) and annual monitoring reports (for actual wood product production). Accounting for wood product carbon must be applied only to actual or baseline volumes of wood harvested from within the Project Area. Trees harvested outside of the Project Area are not part of the Forest Project and must be excluded from any calculations.

**Table 9.12.** Carbon in Harvested Wood Products Verification Items

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Carbon in Harvested Wood Delivered to Mills** | a. Amount of wood harvested that will be delivered to mills has been estimated and reported.<br><br>b. The appropriate wood density factor has been applied and/or water weight subtracted to result in pounds of biomass with zero moisture content.<br><br>c. Total dry weights for all harvested wood have been calculated.<br><br>d. Total carbon weight has been computed.<br><br>e. The total has been converted to metric tonnes of carbon. | Quantification Guidance | No |
| **2. Account for Mill Efficiencies** | The correct mill efficiency factors have been used to calculate total carbon transferred into wood products. | Quantification Guidance | No |
| **3. Wood Product Classification** | The percentages of harvest by wood product class has been determined correctly with verified reports from the mill(s) where the Project Area's logs are sold; or by looking up default wood product classes for the project's Assessment Area(s); or if not available from either of these sources, by classifying all wood products as "miscellaneous." | Quantification Guidance | No |
| **4.Calculation of In-Use and Landfill Carbon Storage** | a. The average amount of carbon stored in in-use wood products over 100 years has been calculated correctly using the worksheets in the Quantification Guidance<br><br>b. The average amount of carbon stored in landfilled wood products over 100 years has been calculated correctly using the worksheets in the Quantification Guidance | Quantification Guidance | No |
| **5. Total Average Carbon Storage in Wood Products Over 100 Years** | Total average carbon storage in wood products over 100 years for a given harvest volume has been calculated and reported. | Quantification Guidance | No |

### 9.3.9 Verifying Calculations of Reversal Risk Ratings and Contributions to the Buffer Pool

At each site visit verification, Project Operators must derive a reversal risk rating for their Forest Project using the worksheets in Appendix A. The worksheets are designed to identify and quantify the specific types of risks that may lead to a reversal, based on project-specific factors.

**Table 9.13.** Reversal Risk Rating Verification Items

| Verification Items | | Section of FPP | Apply Professional Judgment? |
|---|---|---|---|
| **1. Financial Risk** | Use of a Qualified Conservation Easement or Qualified Deed Restriction, occurrence on public lands, or use of a PIA alone. | Appendix A.1 | No |
| **2. Management Risk** | a. Management Risk I – Illegal removals of forest biomass.<br><br>b. Management Risk II – Conversion of Project Area to alternative land uses.<br><br>c. Management Risk III – Over-harvesting. | Appendix A.2 | No |
| **3. Social Risk** | Social Risk. | Appendix A.3 | No |
| **4. Natural Disturbance Risk** | a. Natural Disturbance Risk I – Wildfire<br><br>b. Natural Disturbance Risk II – Disease or insect outbreak.<br><br>c. Natural Disturbance Risk III – Other episodic catastrophic events. | Appendix A.4 | Yes |
| **5. Completing the Risk Rating Analysis** | Reversal risk rating calculated correctly using the formula in Appendix A.5. | Appendix A.5 | No |

## 9.4 Completing the Verification Process

After completing the core project verification activities for a Forest Project, the verification body must do the following to complete the verification process:

1. Complete a Verification Report to be delivered to the Project Operator (public document).
2. Complete a detailed List of Findings containing both immaterial and material findings (if any), and deliver it to the Project Operator (private document).
3. Prepare a concise Verification Statement detailing the vintage and the number of GHG reductions and removals verified, and deliver it to the Project Operator (public document).
4. Verify that the number of GHG reductions and removals, as well as the reversal risk rating, specified in the Verification Report and Statement match the number entered into the Reserve software.
5. Conduct an exit meeting with the Project Operator to discuss the Verification Report, List of Findings, and Verification Statement and determine if material misstatements (if any) can be corrected. If so, the verification body and Project Operator should schedule a

second set of verification activities after the Project Operator has revised the project submission.

6. If a reasonable level of assurance opinion is successfully obtained, upload electronic copies of the Verification Report, List of Findings, Verification Statement, and Verification Activity Log into the Reserve.
7. Return important records and documents to the Project Operator for retention.

The recommended content for the Verification Report, List of Findings, and Verification Statement can be found in the Reserve's Verification Program Manual.[21] The Verification Program Manual also provides further guidance on quality assurance, negative verification statements, use of an optional Project Verification Activity Log, goals for exit meetings, dispute resolution, and record keeping.

[21] Available at http://www.climateactionreserve.org/how/program/program-manual/.

# 10 Glossary of Terms

| | |
|---|---|
| Above-Ground Live Biomass | Live trees including the stem, branches, and leaves or needles, brush and other woody live plants above ground. |
| Activity-Based Funding | The budget line items that are dedicated to agency accomplishments in vegetation management, including pre-commercial thinning, commercial thinning, harvest, hazard tree removal, hazardous fuel reductions, and other management activities designed to achieve forest sustainability health objectives. |
| Additionality | A criterion for Forest Project eligibility. A Forest Project is "additional" if it would not have been implemented without incentives provided by the carbon offset market, including the incentives created through the Climate Action Reserve program. Under this protocol, Forest Projects meet the additionality criterion by demonstrating that they pass a legal requirement test and a performance test, as described in Section 3.1, and by achieving GHG reductions and removals quantified against an approved baseline, determined according to the requirements in Section 6. |
| Affiliate | An "affiliate" is defined as any person or entity that, directly or indirectly, through one or more intermediaries, controls or is controlled by or is under common control with the Forest Owner(s) participating in a project, including any general or limited partnership in which the Forest Owner is a partner and any limited liability company in which the Forest Owner is a member. For the purposes of this definition, "control" means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a person, whether through the ownership of voting securities, by contract or otherwise, and "person" means an individual or a general partnership, limited partnership, corporation, professional corporation, limited liability company, limited liability partnership, joint venture, trust, business trust, cooperative or association or any other legally-recognized entity. |
| Allometric Equation | An equation that utilizes the genotypical relationship among tree components to estimate characteristics of one tree component from another. Allometric equations allow the below ground root volume to be estimated using the above-ground bole volume. |
| Assessment Area | A distinct forest community within geographically identified ecoregions defined by the Reserve that consists of common regulatory and political boundaries that affect forest management. The size of the Assessment Areas is determined by efforts to achieve optimal statistical confidence across multiple scales using U.S. Forest Service Forest Inventory and Analysis Program (FIA) plots |

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| | for biomass. Maps of the Assessment Areas and the associated data may be found on the Reserve's website. |
| Avoidable Reversal | An avoidable reversal is any reversal that is due to the Project Operator's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the Project Area |
| Avoided Conversion Project | A type of Forest Project consisting of specific actions that prevent the conversion of forestland to a non-forestland use by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership. |
| Baseline | The level of GHG emissions, removals, and/or carbon stocks at sources, sinks or reservoirs affected by a Forest Project that would have occurred under a Business As Usual scenario. For the purposes of this protocol, a project's baseline must be estimated following standard procedures in Section 6. |
| Best Management Practices | Management practices determined by a state or designated planning agency to be the most effective and practicable means (including technological, economic, and institutional considerations) of controlling point and nonpoint source pollutants at levels compatible with environmental quality goals.[22] |
| Biological Emissions | For the purposes of the Forest Project Protocol, biological emissions are GHG emissions that are released directly from forest biomass, both live and dead, including forest soils. For Forest Projects, biological emissions are deemed to occur when the reported tonnage of onsite carbon stocks, relative to baseline levels, declines from one year to the next. |
| Biomass | The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass.[23] |
| Bole | A trunk or main stem of a tree. |
| Broadcast Fertilization | A fertilizer application technique where fertilizer is spread across the soil surface. |
| Buffer Pool | The buffer pool is a holding account for Forest Project CRTs administered by the Reserve. It is used as a general insurance mechanism against unavoidable reversals for all Forest Projects registered with the Reserve. If a Forest Project experiences an unavoidable reversal of GHG reductions and removals (as defined in Section 7.3), the Reserve will retire a number of CRTs from the buffer pool equal to the total amount of carbon that was reversed (measured in metric tons of $CO_2$-equivalent). |

[22] (Helms, 1998)
[23] (Metz, Davidson, Swart, & Pan, 2001)

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| Business As Usual | The activities, and associated GHG reductions and removals that would have occurred in the Project Area in the absence of incentives provided by a carbon offset market. Methodologies for determining these activities – and/or for approximating carbon stock levels that would have resulted from these activities – are provided in Section 6 of this protocol for each type of Forest Project. |
| Carbon Pool | A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include above-ground or below-ground biomass or harvested wood products, among others. |
| Climate Reserve Tonne (CRT) | The unit of offset credits used by the Climate Action Reserve. Each Climate Reserve Tonne represents one metric ton (2204.6 lbs) of $CO_2$ reduced or removed from the atmosphere. |
| Common Practice | The average stocks of the live standing carbon pool from within the Forest Project's Assessment Area, derived from FIA plots on all private lands within the defined Assessment Area. |
| Even-Aged Management | Management where the trees in individual forest stands have only small differences in their ages (a single age class). By convention, the spread of ages does not differ by more than 20 percent of the intended rotation. |
| FIA | USDA Forest Service Forest Inventory and Analysis program. FIA is managed by the Research and Development organization within the USDA Forest Service in cooperation with State and Private Forestry and National Forest Systems. FIA has been in operation under various names (Forest Survey, Forest Inventory and Analysis) for 70 years. |
| Forest Carbon | The carbon found in Forestland resulting from photosynthesis in trees and associated vegetation, historically and in the present. Forest Carbon is found in soils, litter and duff, plants and trees, both dead and alive. |
| Forest Management | The commercial or noncommercial growing and harvesting of forests. |
| Forest Owner | A corporation or other legally constituted entity, city, county, state agency, individual(s), or a combination thereof that has legal control (described in Section 2.2) of any amount of forest carbon within the Project Area |
| Forest Project | A planned set of activities designed to increase removals of $CO_2$ from the atmosphere, or reduce or prevent emissions of $CO_2$ to the atmosphere, through increasing and/or conserving forest carbon stocks. |

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| Forest Project Design Document | A standard document for reporting required information about a Forest Project. The Forest Project Design Document must be submitted for review by a verification body and approved by the Reserve before the Forest Project can be registered with the Reserve. |
| Forestland | Land that supports, or can support, at least ten percent tree canopy cover 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. |
| GHG Assessment Boundary | The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs that must be accounted for in quantifying a Forest Project's GHG reductions and removals (Section 6). 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 mobile combustion GHG emissions. |
| GHG Reductions and Removals | See definitions for Reduction and Removal. |
| Greenhouse Gases (GHG) | Gases that contribute to global warming and climate change. For the purposes of this Forest Project Protocol, GHGs are the six gases identified in the Kyoto Protocol: carbon dioxide ($CO_2$), nitrous oxide ($N_2O$), methane ($CH_4$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$). |
| Improved Forest Management Project | A type of Forest Project involving management activities that increase carbon stocks on forested land relative to baseline levels of carbon stocks. |
| Listed | A Forest Project is considered "listed" when the Project Operator has created an account with the Reserve, submitted the required Project Submittal form and other required documents, paid the project submission fee, and the Reserve has approved and accepted the project for listing. |
| Litter | Any piece(s) of dead woody material from a tree, e.g. dead boles, limbs, and large root masses, on the ground in forest stands that is smaller than material identified as lying dead wood. |
| Lying Dead Wood | Any piece(s) of dead woody material from a tree, e.g. dead boles, limbs, and large root masses, on the ground in forest stands. Lying dead wood is all dead tree material with a minimum average diameter of five inches and a minimum length of eight feet. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood. |

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| Metric ton or "tonne" (MT, t) | A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1 short tons. |
| Native Forest | For the purposes of this protocol native forests shall be defined as those occurring naturally in an area, as neither a direct nor indirect consequence of human activity post-dating European settlement. |
| Natural Forest Management | Forest management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple landscape scales. The application of this definition, its principles, detailed definition, and implementation are discussed further in Section 3.11.2. |
| Non-Forest Cover | Land with a tree canopy cover of less than ten percent. |
| Non-Forest Land Use | An area managed for residential, commercial, or agricultural uses other than for the production of timber and other forest products, or for the maintenance of woody vegetation for such indirect benefits as protection of catchment areas, wildlife habitat, or recreation. |
| Non-Harvest Disturbance | Reduction in forest cover that is not a direct result of harvest, such as wildfire and insect disturbances. |
| Onsite Carbon Stocks | Carbon stocks in living biomass, dead biomass, and soils within the Project Area. |
| Permanence | The requirement that GHGs must be permanently reduced or removed from the atmosphere to be credited as carbon offsets. For Forest Projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years. |
| Primary Effects | The Forest Project's intended changes in carbon stocks, GHG emissions or removals. |
| Professional Forester | A professional engaged in the science and profession of forestry. A professional forester is credentialed in jurisdictions that have professional forester licensing laws and regulations. Where a jurisdiction does not have a professional forester law or regulation then a professional forester is defined as having the Certified Forester credentials managed by the Society of American Foresters (see www.certifiedforester.org). |
| Project Area | The area inscribed by the geographic boundaries of a Forest Project, as defined following the requirements in Section 4 of this protocol. Also, the property associated with this area. |
| Project Life | Refers to the duration of a Forest Project and its associated monitoring and verification activities, as defined in Section 3.4. |

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| Public Lands | Lands that are owned by a public governmental body such as a municipality, county, state or country. |
| Project Operator | A Forest Owner responsible for undertaking a Forest Project and registering it with the Reserve. The Forest Owner who executes the Project Implementation Agreement, as described in Section 2.2. |
| Qualified Conservation Easement | A qualified conservation easement must explicitly refer to the terms and conditions of the Project Implementation Agreement, apply to current and all subsequent Project Operators for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol. |
| Qualified Deed Restriction | A qualified deed restriction shall ensure that the Project Implementation Agreement runs with the land and applies to all current and subsequent Project Operators for the full duration of the Forest Project's minimum time commitment, as defined in Section 3.4 of this protocol, to be determined in the Reserve's reasonable discretion. A deed restriction is not "qualified" if it merely consists of a recording of the Project Implementation Agreement or a notice of the Project Implementation Agreement, as such a recording is already required by the Project Implementation Agreement. |
| Reduction | The avoidance or prevention of an emission of $CO_2$ (or other GHG). Reductions are calculated as gains in carbon stocks over time relative to a Forest Project's baseline (also see Removal). |
| Reforestation Project | A type of Forest Project involving the restoration of tree cover on land that currently has no, or minimal, tree cover. |
| Registered | A Forest Project becomes registered with the Reserve when it has been verified by a Reserve-approved and ISO-accredited verification body, all required documentation (see Section 8) has been submitted by the Project Operator to the Reserve for final approval, and the Reserve approves the project. |
| Removal | Sequestration ("removal") of $CO_2$ from the atmosphere caused by a Forest Project. Removals are calculated as gains in carbon stocks over time relative to a Forest Project's baseline (also see Reduction). |
| Reporting Period | The period of time over which a Project Operator quantifies and reports GHG reductions and removals. Reporting periods for Forest Projects generally have a required duration of 12 months, with two exceptions:<br>1. A Forest Project's first reporting period is the project's start date. No CRTs are issued with the first Reporting Period.<br>2. A Forest Project's second reporting period may be any time less than 12 months and at least a day, |

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| | but no greater than 12 months. This is provided so that Project Operators can establish a suitable time for annual reporting. |
| Reservoir | Physical unit or component of the biosphere, geosphere or hydrosphere with the capacity to store or accumulate carbon removed from the atmosphere by a sink, or captured from a source. |
| Retire | To retire a CRT means to transfer it to a retirement account in the Climate Action Reserve's software system. Retirement accounts are permanent and locked, so that a retired CRT cannot be transferred or retired again. |
| Reversal | A reversal is a decrease in the stored carbon stocks associated with quantified GHG reductions and removals that occurs before the end of the Project Life. Under this protocol, a reversal is deemed to have occurred if there is a decrease in the difference between project and baseline onsite carbon stocks from one year to the next, regardless of the cause of this decrease (i.e. if the result of ($\Delta$ $AC_{onsite}$ - $\Delta$ $BC_{onsite}$) in Equation 6.1 is negative). |
| Secondary Effects | Unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the Forest Project. |
| Sequestration | The process of increasing the carbon (or other GHGs) stored in a reservoir. Biological approaches to sequestration include direct removal of $CO_2$ from the atmosphere through land-use changes[24] and changes in forest management. |
| Significant Disturbance | Any natural impact that results in a loss of least 20 percent of the above-ground live biomass that is not the result of intentional or grossly negligent acts of the Project Operator. |
| Sink | Physical unit or process that removes a GHG from the atmosphere. |
| Source | Physical unit or process that releases a GHG into the atmosphere. |
| Standing Dead Carbon Stocks | The carbon in standing dead trees. Standing dead trees include the stem, branches, roots, or section thereof, regardless of species, with minimum diameter (breast height) of five inches and a minimum height of 15 feet. Stumps are not considered standing dead stocks. |
| Standing Live Carbon Stocks | The carbon in the live tree pool. Live trees include the stem, branches, roots, and leaves or needles of all above-ground live biomass, regardless of species, with a minimum diameter (breast height) of five inches and a minimum height of 15 feet (inventory methodology must include all trees five inches and greater) |

[24] (Metz, Davidson, Swart, & Pan, 2001)

| | |
|---|---|
| Stocks (or Carbon Stocks) | The quantity of carbon contained in identified carbon pools. |
| Submitted | The Reserve considers a Forest Project to be "submitted" when all of the appropriate forms have been uploaded and submitted to the Reserve's software system, and the Project Operator has paid a project submission fee. |
| Tree | A woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of five inches and a minimum height of 15 feet with no branches within three feet from the ground at maturity.[25] |
| Unavoidable Reversal | An unavoidable reversal is any reversal not due to the Project Operator's negligence, gross negligence or willful intent, including wildfires or disease that are not the result of the Project Operator's negligence, gross negligence or willful intent. |
| Uneven-Aged Management | Management that leads to forest stand conditions where the trees differ markedly in their ages, with trees of three or more distinct age classes either mixed or in small groups. |
| Verification | The process of reviewing and assessing all of a Forest Project's reported data and information by an ISO-accredited and Reserve-approved verification body, to confirm that the Project Operator has adhered to the requirements of this protocol. |
| Verification Period | The period of time over which GHG reductions/removals are verified. A verification period may cover multiple reporting periods. The end date of any verification period must correspond to the end date of a reporting period. |

[25] (Helms 1998)

# Appendix A Determination of a Forest Project's Reversal Risk Rating

Project Operators must derive a reversal risk rating for their Forest Project using the worksheets in this section. The worksheets are designed to identify and quantify the specific types of risks that may lead to a reversal, based on project-specific factors. Reforestation Projects that defer the verification of an inventory until the second verification shall defer the determination of a reversal risk rating until the second verification when the project has a verified inventory.

This risk assessment must be updated every time the project undergoes a verification site visit. Therefore, a project's risk profile and its assessment are dynamic. Furthermore, estimated risk values and associated mitigation measures will be updated periodically by the Reserve as improvements in quantifying risks or changes in risks are determined. Any adjustments to the risk ratings will affect only current and future year contributions to the Buffer Pool. The Reserve may, from time to time, transfer Climate Reserve Tonnes (CRTs) from the Buffer Pool to the Project Operator's account if the Reserve determines that previously assessed risk ratings were unnecessarily high. Alternatively, the Reserve may waive a Project Operator's future contributions to the Buffer Pool until excess contributions from previous years are recouped. If a Forest Project's risk rating increases, the Project Operator must contribute additional CRTs to the Buffer Pool to ensure that all CRTs (including those issued in prior years) are properly insured.

Risks that may lead to reversals are classified into the categories identified in Table A.1.

**Table A.1.** Forest Project Risk Types

| Risk Category | Risk Type | Description | How Risk is Managed in this Protocol |
|---|---|---|---|
| Financial | Financial Failure Leading to Bankruptcy | Financial failure can lead to bankruptcy and/or alternative management decisions to generate income that result in reversals through over-harvesting or conversion | Default Risk |
| | Project Implementation Agreement (PIA) Subordination | Subordinating the PIA to mortgages or deeds on or affecting the Project | Default Risk |
| Management | Illegal Harvesting | Loss of project stocks due to timber theft | Default by Area |
| | Conversion to Non-Forest Uses | Alternative land uses are exercised at project carbon expense | Default Risk |
| | Over-Harvesting | Exercising timber value at expense of project carbon | Default Risk |
| Social | Social Risks | Changing government policies, regulations, and general economic conditions | Default Risk |
| Natural Disturbance | Wildfire | Loss of project carbon through wildfire | Risk and Risk-Mitigation Worksheet |
| | Disease/Insects | Loss of project carbon through | Default Risk |

| Risk Category | Risk Type | Description | How Risk is Managed in this Protocol |
|---|---|---|---|
| | | disease and/or insects | |
| | Other Episodic Catastrophic Events | Loss of project carbon from wind, snow and ice, or flooding events | Default Risk |

## A.1 Financial Risk

Financial failure of an organization resulting in bankruptcy can lead to dissolution of agreements and forest management activities to recover losses that result in reversals. Projects that employ a Qualified Conservation Easement or Qualified Deed Restriction, or that occur on public lands, are at a lower risk than projects with a PIA alone.

**Table A.2.** Financial Risk Identification

| Applies to all projects | | |
|---|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** | |
| | PIA only | PIA combined with Qualified Conservation Easement or Qualified Deed Restriction or on public lands |
| Default Financial Risk | 5% | 1% |

**Table A.3.** PIA Subordination

| Applies to all projects | | |
|---|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** | |
| | PIA with "Subordination Clause Type II" | PIA with "Subordination Clause Type I" |
| Default Financial Risk | 10% | 2% |

## A.2 Management Risk

Management failure is the risk of management activities that directly or indirectly could lead to a reversal. Projects that employ a conservation easement or deed restriction, or that occur on public lands, are exempt from this risk category.

### Management Risk I – Illegal Removals of Forest Biomass

Illegal logging occurs when biomass is removed either by trespass or outside of a planned set of management activities that are controlled by regulation. Illegal logging is exacerbated by lack of controls and enforcement activities.

**Table A.4.** Risk of Illegal Removals of Forest Biomass

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| United States Default Harvesting Risk | 0% |

### Management Risk II – Conversion of Project Area to Alternative Land Uses

High values for development of housing and/or agriculture may compete with timber and carbon values and lead to a change in land use that affects carbon stocks. The risk of conversion of any Project Area to other non-forest uses is related to the probability of alternative uses, which are affected by many variables, including population growth, topography, proximity to provisions and metropolitan areas, availability of water and power, and quality of access to the Project Area.

**Table A.5.** Risk of Conversion to Alternative Land Use

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| With Qualified Conservation Easement or Qualified Deed Restriction that explicitly encumbers all development rights | 0% |
| Without Qualified Conservation Easement or Qualified Deed Restriction | 2% |

### Management Risk III – Over-Harvesting

Favorable timber values, among other reasons, may motivate some project managers to realize timber values at the expense of managing carbon stocks for which CRTs have been credited. Additionally, reversals can occur as the result of harvest associated with fuels treatments.

**Table A.6.** Risk of Over-Harvesting

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| With Qualified Conservation Easement or Qualified Deed Restriction that explicitly encumbers timber harvesting associated with project stocks | 0% |
| Without Qualified Conservation Easement or Qualified Deed Restriction | 2% |

## A.3 Social Risk

Social risks exist due to changing government policies, regulations, and general economic conditions. The risks of social or political actions leading to reversals are low, but could be significant.

**Table A.7.** Social Risk Identification

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| United States Default Social Risk | 2% |

## A.4 Natural Disturbance Risk

Natural disturbances can pose a significant risk to the permanency GHG reductions and removals. Natural disturbance risks are only partially controllable by management activities. Management activities that improve resiliency to wildfire, insects, and disease can reduce these risks. Management activities that shift harvesting practices from live sequestering trees to trees that have succumbed to natural disturbances reduce or negate the reversal depending on the size and location of the disturbance.

### Natural Disturbance Risk I – Wildfire

A wildfire has the potential to cause significant reversals, especially in certain carbon pools. These risks can be reduced by certain techniques including reducing surface fuel loads, removing ladder fuels, adding fuel breaks, and reducing stand density. However, these techniques cannot reduce emission risk to zero because all landowners will not undertake fuel treatments, nor can they prevent wildfire from occurring.

**Table A.8.** Natural Disturbance Risk I – Wildfire

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| For the Assessment Area the project is located in, determine long-term fire risk potential from fire history perimeter maps (at least 30 years) – enter rate as an annualized percentage.* | X% |
| If fuel treatments have been implemented for the Project Area, reduce the value above by the appropriate percent as indicated below.** | (X%) **x** Y% |

* If the project proponent has more property specific fire data of at least 30 years in duration that may be used in lieu of the regional Assessment Area values.

** Depending on the level of fuel treatments the Y% is set as follows: high level of fuel treatments = 50%, medium level of fuel treatments = 66.3%, low level of fuel treatments = 82.6%, no fuel treatments = 100%.

### Natural Disturbance Risk II – Disease or Insect Outbreak

A disease or insect outbreak has the potential to cause a reversal, especially in certain carbon pools.

**Table A.9.** Natural Disturbance Risk II – Disease or Insect Outbreak

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |

| | |
|---|---|
| Default Risk Contribution from Disease or Insect Outbreak | 3% |

**Natural Disturbance Risk III – Other Episodic Catastrophic Events**

A major wind-throw event (hurricane, tornado, high wind event) has the potential to cause a reversal, especially in certain carbon pools.

**Table A.10.** Natural Disturbance Risk III – Other Episodic Catastrophic Events

| Applies to all projects | |
|---|---|
| **Identification of Risk** | **Contribution to Reversal Risk Rating** |
| Default Risk Contribution from Other Catastrophic Events | 3% |

## A.5 Summarizing the Risk Analysis and Contribution to Buffer Pool

Use the table below to summarize the Forest Project's reversal risk rating. As indicated above, projects that employ a conservation easement or deed restriction, or that occur on public lands, are exempt from certain risk categories. Such Qualified Conservation Easements and Qualified Deed Restrictions must clearly identify the goals and objectives of the Forest Project according to the terms of this protocol.

**Table A.11.** Project Contribution to the Buffer Pool Based on Risk

| Risk Category | Contribution from Risk Descriptions Above | | |
|---|---|---|---|
| | Source | PIA Only | PIA and Qualified Conservation Easement and/or a Qualified Deed Restriction and/or Public Ownership |
| Financial Failure[26] | Default Risk -Remedies for reversals addressed in PIA | 15% or 7% | 11% or 3% |
| Illegal Forest Biomass Removal | Default Risk | 0% | 0% |
| Conversion | Default Risk - Remedies for reversals addressed in PIA | 2% | 0% |
| Over-Harvesting | Default Risk - Remedies for reversals addressed in PIA | 2% | 0% |
| Social | Default Risk | 2% | 2% |
| Wildfire | Calculated Risk from worksheet | X% | X% |
| Disease or Insect Outbreak | Calculated Risk from worksheet | 3% | 3% |
| Other Catastrophic Events | Calculated Risk from worksheet | 3% | 3% |

[26] When determining the appropriate risk rating for the Financial Failure Risk Category, use the higher value if intending to use PIA Subordination Clause Type I and the lower value if intending to use PIA Subordination Clause Type II. Please refer to the Project Implementation Agreement on the Reserve website for further information.

**Completing the Risk Rating Analysis**

The project's reversal risk rating is calculated as follows:

$$100\% - \left( \begin{array}{l} (1 - FinancialFailure\%) \times (1 - IllegalForestBiomassRemoval\%) \times (1 - Conversion\%) \\ \times (1 - OverHarvesting\%) \times (1 - SocialRisk\%) \times (1 - Wildfire\%) \times (1 - Disease/InsectOutbreak\%) \\ \times (1 - OtherCatastrophicEvents\%) \end{array} \right)$$

# Appendix B Reforestation Project Eligibility

This appendix presents a standardized approach to determine whether reforestation activities on lands that have undergone a Significant Disturbance are likely to be Business As Usual – and therefore not eligible for registration with the Reserve – based on the net present value for the timber expected to be produced from reforestation. A Reforestation Project is considered Business As Usual if the net present value for expected timber is $0 or more according to standard assumptions underlying Table B.1.

To determine whether a Reforestation Project is eligible, perform the following steps:

1. Identify whether site preparation costs[27] are High or Low:
    a. Site preparation costs are High if:
        i. Competing species management (including mechanical removal and/or use of herbicides) has been or will be conducted on 50 percent or more of the Project Area; or
        ii. Soil ripping has occurred on more than 50 percent of the Project Area.
    b. Site preparation costs are Low for all other projects.

2. Identify the value of harvested products (High, Medium, Low, or Very Low) corresponding to the project's Assessment Area, from the lookup table in the most current Assessment Area Data File, available on the Forest Project Protocol webpage.

3. Identify the standard Rotation Age for the project's Assessment Area, from the lookup table in the most current Assessment Area Data File, available on the Forest Project Protocol webpage.

4. Identify the site class category for the Project Area. The category must be consistent with the stated site productivity in the project's submission form to the Reserve. Projects with mixed site classes must round to the nearest site class category based on a weighted average.
    a. Site Classes I and II are classified as 'Higher'.
    b. Site Classes III, IV, and V are classified as 'Lower'.

5. Determine whether the project is "eligible" or "not eligible" according to the identified site preparation costs, value of harvested products, rotation age, and site class, as indicated in Table B.1.

[27] All projects are assumed to have similar costs related to the cost of seedlings and planting; site preparation costs, however, can vary depending on circumstances.

**Table B.1.** Determination of Reforestation Project Eligibility

| Site Preparation Costs | Value of Harvested Products | Rotation Age (Years) | Site Class | Eligibility | Scenario # |
|---|---|---|---|---|---|
| High Site Preparation | High | <60 | Higher | Not Eligible | 1 |
| | | | Lower | Not Eligible | 2 |
| | | >=60 | Higher | Eligible | 3 |
| | | | Lower | Eligible | 4 |
| | Medium | <50 | Higher | Not Eligible | 5 |
| | | | Lower | Not Eligible | 6 |
| | | 50 - 59 | Higher | Not Eligible | 7 |
| | | | Lower | Eligible | 8 |
| | | >=60 | Higher | Eligible | 9 |
| | | | Lower | Eligible | 10 |
| | Low | <30 | Higher | Not Eligible | 11 |
| | | | Lower | Eligible | 12 |
| | | >=30 | Higher | Eligible | 13 |
| | | | Lower | Eligible | 14 |
| | Very Low | >=30 | Higher | Eligible | 15 |
| | | | Lower | Eligible | 16 |
| Low Site Preparation | High | <60 | Higher | Not Eligible | 17 |
| | | | Lower | Not Eligible | 18 |
| | | 60 - 69 | Higher | Not Eligible | 19 |
| | | | Lower | Eligible | 20 |
| | | >=70 | Higher | Eligible | 21 |
| | | | Lower | Eligible | 22 |
| | Medium | <50 | Higher | Not Eligible | 23 |
| | | | Lower | Not Eligible | 24 |
| | | 50 - 59 | Higher | Not Eligible | 25 |
| | | | Lower | Eligible | 26 |
| | | >=60 | Higher | Eligible | 27 |
| | | | Lower | Eligible | 28 |
| | Low | < 30 | Higher | Not Eligible | 29 |
| | | | Lower | Not Eligible | 30 |
| | | 30 - 49 | Higher | Not Eligible | 31 |
| | | | Lower | Eligible | 32 |
| | | >=50 | Higher | Eligible | 33 |
| | | | Lower | Eligible | 34 |
| | Very Low | >=30 | Higher | Eligible | 35 |
| | | | Lower | Eligible | 36 |
| | | <30 | Higher | Not Eligible | 37 |
| | | | Lower | Not Eligible | 38 |

California Environmental Protection Agency

**AIR RESOURCES BOARD**

# Compliance Offset Protocol

# U.S. Forest Projects

Adopted: June 25, 2015

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# Table of Contents

## Chapter 1. Purpose and Definition

### 1.1. Purpose

(a) The purpose of the Compliance Offset Protocol U.S. Forest Projects (protocol) is to quantify greenhouse gas emission reductions and greenhouse gas removal enhancements associated with the sequestration of carbon achieved by increasing and/or conserving forest carbon stocks.

(b) AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA);[1] however those elements of the protocol are still regulatory. The exemption allows future updates to the quantification methodologies to be made through a public review and Board adoption process but without the need for rulemaking documents. Each protocol identifies sections that are considered quantification methodologies and exempt from APA requirements. Any changes to the non-quantification elements of the offset protocols would be considered a regulatory update subject to the full regulatory development process. Those sections that are considered to be a quantification methodology are clearly indicated in the title of the chapter or subchapter if only a portion of that chapter is considered part of the quantification methodology of the protocol.

### 1.2. Definitions

(a) For the purposes of this protocol, the following definitions apply:

(1) "Above-Ground Live Biomass" means the total mass of biomass in live trees including the stem, branches, and leaves or needles, brush and other woody live plants above ground.

(2) "Accuracy" is defined in section 95102 of the Mandatory Reporting Regulation.

(3) "Activity-Based Funding" means the budget line items that are dedicated to agency accomplishments in vegetation management, including pre-commercial thinning, commercial thinning, harvest, hazard tree removal,

[1] Health and Safety Code section 38571.

hazardous fuel reductions, and other management activities designed to achieve forest sustainability health objectives.

(4) “Allometric Equation” means an equation that utilizes the genotypical relationship among tree components to estimate characteristics of one tree component from another. Allometric equations allow the below-ground root volume to be estimated using the above-ground bole volume.

(5) “Assessment Area” means a distinct forest community within geographically identified ecoregions that consists of common regulatory and political boundaries that affect forest management. The size of an assessment area is determined by efforts to achieve optimal statistical confidence across multiple scales using U.S. Forest Service Forest Inventory and Analysis Program (FIA) plots for biomass. Maps of the assessment areas and the associated data may be found on ARB’s website.

(6) “Avoided Conversion Project” means a type of forest project consisting of specific actions that prevent the conversion of privately owned forestland to a non-forest land use by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership.

(7) “Basal Area” means the cross-sectional area of a tree at breast height calculated from diameter at breast height.

(8) “Basal Area Retention” means the average basal area per acre remaining in a harvest unit after a harvest. Basal area within a harvest unit is averaged on a per acre basis including standing live trees equal to or greater than 1 inch in diameter at breast height within the harvest, regardless of species.

(9) “Best Management Practices” means management practices determined by a state or designated planning agency to be the most effective and practicable means (including technological, economic, and institutional considerations) of protecting the beneficial uses of water, soil stability, forest productivity, and wildlife.

(10) “Bias” is defined in section 95102 of the Mandatory Reporting Regulation.

(11) “Biological Emissions” means greenhouse gas emissions that are released directly from forest biomass, both live and dead, including forest soils. For forest projects, biological emissions are deemed to occur when the reported

tonnage of onsite carbon stocks, relative to baseline levels, declines from one reporting period to the next.

(12) "Bole" means a trunk or main stem of a tree.

(13) "Broadcast Fertilization" means a fertilizer application technique where fertilizer is spread across the soil surface.

(14) "Cap-and-Trade Regulation" or "Regulation" means ARB's regulation establishing the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms as set forth in title 17, California Code of Regulations, chapter 1, subchapter 10, article 5 (commencing with section 95800).

(15) "Carbon Pool" means a greenhouse gas reservoir.

(16) "Clearcutting" means a regeneration method involving the removal of a stand in one harvest. Regeneration after harvesting shall be obtained by direct seeding, planting, sprouting, or by natural seed fall. When practical, clearcuts shall be irregularly shaped and variable in size to mimic natural patterns and features found in landscapes.

(17) "Commercially Viable" means profitable, either without subsidies or with reliable, long-term subsidies. The assessment of commercial viability shall be determined by analysis of comparable practices within the assessment area on comparable conditions (slope, soils, access to markets, etc.). For grazing, if the level of grazing activity has been equal to or less than 0.5 Animal Unit Months (AUMs) per acre, the grazing activity is not commercially viable.

(18) "Common Practice" means, for the purposes of this protocol, the average carbon stocks (metric tons) of the above-ground portion of standing live trees from within the forest project's assessment area, derived from FIA plots on all private lands within the defined assessment area.

(19) "Confidence Deduction" means a deduction applied to the project's onsite carbon stocks for each reporting period to account for statistical uncertainty associated with sampling in order to ensure that estimates of GHG emission reductions and GHG removal enhancements are conservative.

(20) “Countable Tree” means a tree that must be in place at least two growing seasons and must be live and healthy.

(21) “Cropland” means land under cultivation including cropland harvested, crop failures, cultivated summer fallow, idle cropland, and cropland used only for pasture as defined by the United States Department of Agriculture.

(22) “Even-Aged Management” means a silvicultural system that includes clearcutting, seed tree, and shelterwood regeneration methods. Any harvest activity that does not meet the stocking requirements of subchapter 3.1(a)(4)(D) is also considered even-aged management, unless a state agency with jurisdiction over the project area identifies the practice as uneven-aged management. By convention, the spread of ages does not differ by more than 20 percent of the intended rotation.

(23) “Forest Management” means the commercial or noncommercial growing and harvesting of forests.

(24) “Forest Owner” means the owner of any interest in the real (as opposed to personal) property involved in a forest offset project, excluding government agency third-party beneficiaries of conservation easements. Generally, a Forest Owner is the owner in fee of the real property involved in a forest offset project. In some cases, one entity may be the owner in fee while another entity may have an interest in the trees or the timber on the property, in which case all entities or individuals with interest in the real property are collectively considered the Forest Owners, however, a single Forest Owner must be identified as the Offset Project Operator.

(25) “Forest Project” means a planned set of activities designed to increase removals of $CO_2$ from the atmosphere, or reduce or prevent emissions of $CO_2$ to the atmosphere, through increasing and/or conserving forest carbon stocks.

(26) “Forestland” means land that supports, or can support, at least 10 percent tree canopy cover 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.

(27) “Harvest Unit” means an area of forest vegetation that has been harvested as a cohesive unit and generally has uniform distribution of retained vegetation.

(28) “Improved Forest Management Project” or “IFM Project” means a type of forest project involving management activities that increase carbon stocks on forested land relative to baseline levels of carbon stocks.

(29) “Intentional Back Burn” means a controlled burn set by, or at the request of, a local, state, or federal fire protection agency for the purpose of protecting forestlands from an advancing wildfire that began on another property through no negligence, gross negligence, or willful misconduct of the forest owner.

(30) “Litter” means any piece(s) of dead woody material from a tree, e.g., dead boles, limbs, leaves, and large root masses, on the ground in forest stands that is smaller than material identified as lying dead wood.

(31) “Logical Management Unit” or “LMU” means all land that the forest owner(s) and its affiliate(s) either own in fee or hold timber rights on and that are within the same assessment area(s) where the project is located. An LMU may be further defined by its unique biological, geographical, and/or geological attributes, delimited by watershed boundaries and/or elevational zones, and/or unique road networks, and/or an area that has experienced natural disturbance such as wildfire or windstorm, and/or areas designated as High Conservation Value Forest (HCVF) by a state agency with jurisdiction over the project area or as identified by the forest owner’s Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), or Tree Farm certification.

(32) “Lying Dead Wood” means any piece(s) of dead woody material from a tree, e.g., dead boles, limbs, and large root masses, on the ground in forest stands. Lying dead wood is all dead tree material with a minimum average diameter of five inch and a minimum length of eight feet. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood.

(33) “Native Forest” means forests occurring naturally in an area, as neither a direct nor indirect consequence of human activity post-dating European settlement.

(34) “Natural Forest Management” means forest management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple landscape scales. The application of this definition, its principles, detailed definition, and implementation are discussed further in subchapter 3.1.

(35) “Non-Forest Cover” means land with a tree canopy cover of less than 10 percent.

(36) “Non-Forest Land Use” means an area managed for uses other than for the production of timber and other forest products or for the maintenance of woody vegetation for such indirect benefits as protection of catchment areas, wildlife habitat, or recreation.

(37) “Non-Harvest Disturbance” means a reduction in forest cover that is not a direct result of harvest, such as wildfire and insect disturbances.

(38) “Onsite Carbon Stocks” means the quantity of carbon contained in the following carbon pools, if classified as an included carbon pool per the project type-specific offset project boundary: carbon stocks in all portions of standing live and standing dead trees, shrubs and herbaceous understory, and soil.

(39) “Primary Effect” means the forest project’s intended changes in carbon stocks, greenhouse gas emissions, or greenhouse gas removals.

(40) “Professional Forester” means a professional engaged in the science and profession of forestry. For forest projects that occur in a jurisdiction that has professional forester licensing laws and regulations, a professional forester must be credentialed in that jurisdiction. Where a jurisdiction does not have a professional forester law or regulation, then a professional forester is defined as either having the Certified Forester credentials managed by the Society of American Foresters, or other valid professional forester license or credential approved by a government agency in a different jurisdiction. For forest projects that occur on the categories of land in subchapter 3.2(f) of

this protocol, a Professional Forester with credentials managed by the Society of American Foresters, Tribal Forest Manager, Tribal Timber Sale Officer, Tribal or BIA Officer in Charge, or BIA Regional Forester is sufficient

(41) "Project Area" means the property associated with the geographic boundaries of a forest project, as defined following the requirements in chapter 2 of this protocol.

(42) "Project Life" means the period of time between offset project commencement and a period of 100 years following the issuance of any ARB or registry offset credit for GHG emission reductions or GHG removal enhancements achieved by the offset project.

(43) "Public Lands" means lands that are owned by a public governmental body such as a municipality, county, state, or country. The lands in subchapter 3.2(f) are not considered public lands for purposes of calculating the project baseline in chapter 5.

(44) "Qualified Conservation Easement" means a conservation easement that explicitly refers to the requirements of the regulation and this protocol and apply to current and all subsequent forest owners for the full duration of the forest project's life. To be "qualified" for purposes of ARB's compliance offset program, the conservation easement must be granted by the owner in fee to a qualified holder of a conservation easement in accordance with the conservation easement enabling statute of the state in which the project is located; be perpetual in duration; and expressly acknowledge that ARB is a third-party beneficiary of the conservation easement with the right to enforce all obligations under the easement and all other rights and remedies, including standing as an interested party in any proceeding affecting the easement, conveyed to the holder of the easement.

(45) "Reforestation Project" means a type of forest project involving the restoration of tree cover on land that currently has no, or minimal, tree cover.

(46) "Salvage Harvest" means the removal of only those trees which are dead, dying, or deteriorating, because of damage from fire, wind, insects, disease,

flood, or other injurious agent. Salvage provides for the economic recovery of trees prior to a total loss of their wood product value.

(47) “Secondary Effects” means unintended changes in carbon stocks, greenhouse gas emissions, or greenhouse gas removals caused by the forest project.

(48) “Seed Tree” means a regeneration method that involves the removal of a stand in one harvest except for well-distributed seed trees of desired species which are left singly or in groups to restock the harvested area. The seed step is utilized to promote natural reproduction from seed and to initiate the establishment of an even-aged stand. The removal step may be utilized to remove the seed trees after a fully stocked stand of reproduction has become established.

(49) “Shelterwood” means a regeneration method that reproduces a stand via a series of harvests (preparatory, seed, and removal). The preparatory step is utilized to improve the crown development, seed production capacity, and wind firmness of designated seed trees. The seed step is utilized to promote natural reproduction from seed. The removal step is utilized when a fully stocked stand of reproduction has become established. The removal step includes the removal of the protective overstory trees. The shelterwood regeneration method is normally utilized when some shade canopy is considered desirable for the establishment of regeneration.

(50) “Significant Disturbance” means any natural impact that results in a loss of at least 20 percent of the above-ground standing live tree carbon stocks that is not the result of intentional or grossly negligent acts of the forest owner.

(51) “Sound Cubic-Foot Volume” or “VOLCFSND,” in reference to trees where the diameter is measured at breast height (DBH), means the volume of sound wood in the central stem of a sample tree ≥5.0 inches in diameter from a 1-foot stump to a minimum 4-inch top diameter or to where the central stem breaks into limbs all of which are <4.0 inches in diameter. For woodland species VOLCFSND is the net volume of wood and bark from the diameter at root collar (DRC) measurement point(s) to a minimum 1½ -inch top diameter; includes branches that are at least 1½ inches in diameter

along the length of the branch. This is a per tree value and must be multiplied by trees per acre of unadjusted growth trees to obtain per acre information. This is not used for trees with <5.0 inches. Sound Cubic-Foot Volume does not include rotten and missing cull (volume loss due to rotten and missing cull defect has been deducted).

(52) “Species Diversity Index” means the maximum amount of any one native species allowed within a project, by percentage.

(53) “Stand” means an individual unit or polygon that is relatively homogeneous in terms of the carbon stocking within its borders. For live and dead trees, the determination of stand boundaries is usually based on forest vegetation attributes, such as species, size (age), and density characteristics. For soils, the determination of soil stand boundaries is made on similar soil types.

(54) “Standing Dead Tree Carbon Stocks” means the carbon in standing dead trees. Standing dead trees include the stem, branches, roots, or section thereof, regardless of species, with a minimum diameter at breast height of five inches and a minimum height of 15 feet. Stumps are not considered standing dead stocks.

(55) “Standing Live Tree Carbon Stocks” means the carbon in standing live trees. Live trees include the stem, branches, and roots, regardless of species, with a minimum diameter at breast height of five inches and a minimum height of 15 feet.

(56) “Stocks” or “Carbon Stocks” means the quantity of carbon contained in an identified greenhouse gas reservoir (or carbon pool).

(57) “Strata,” plural of stratum (see below), means the set of different groupings for a specific attribute, such as vegetation or soil.

(58) “Stratum” means a group of stands that contain a similar attribute, such as vegetation or soils attributes.

(59) “Tree” means a woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of 5 inches and a

minimum height of 15 feet with no branches within 3 feet from the ground at maturity.

(60) "Uneven-Aged Management" means management that leads to forest stand conditions where the trees differ markedly in their ages, with trees of three or more distinct age classes either mixed or in small groups.

(b) For terms not defined in subchapter 1.2(a), the definitions in section 95802 of the Cap-and-Trade Regulation (Regulation) apply.

(c) For purposes of this protocol, the following acronyms apply:

(1) "AB 32" means Assembly Bill 32, the Global Warming Solutions Act of 2006.

(2) "ACD" means avoided conversion project discount factor.

(3) "APA" means the Administrative Procedure Act.

(4) "ARB" means the California Air Resources Board.

(5) "BIA" means the Bureau of Indian Affairs.

(6) "C" means carbon.

(7) "$CH_4$" means methane.

(8) "$CO_2$" means carbon dioxide.

(9) "$CO_2e$" means carbon dioxide equivalent.

(10) "CP" means common practice.

(11) "CRM" means component ratio method.

(12) "DBH" means diameter at breast height.

(13) "FIA" means USDA Forest Service Forest Inventory and Analysis program.

(14) "HSR" means high stocking reference.

(15) "GHG" means greenhouse gas.

(16) "GIS" means geographic information systems.

(17) "HCP" means habitat conservation plan.

(18) "ICS" means initial above-ground standing live tree carbon stocks per acre.

(19) "IFM" means improved forest management.

(20) "lb" means pound.

(21) "LMU" means logical management unit.

(22) "MBL" means minimum baseline level for above-ground standing live tree carbon stocks.

(23) "MT" means metric ton.

(24) "$N_2O$" means nitrous oxide.

(25) "OPDR" means Offset Project Data Report.

(26) "SHA" means safe harbor agreement.

(27) "SSR" means GHG sources, sinks, and reservoirs.

(28) "THP" means timber harvesting plan.

(29) "QA/QC" means quality assurance and quality control.

(30) "USFS" means United States Forest Service.

(31) "VOLCFSND" means sound cubic-foot volume.

(32) "WCS" means weighted average above-ground standing live tree carbon stocks.

## Chapter 2. Eligible Activities – Quantification Methodology

This protocol includes three forest management activities designed to increase removals of $CO_2$ from the atmosphere or reduce or prevent emissions of $CO_2$ to the atmosphere through increasing and/or conserving forest carbon stocks. The following types of forest management activities are eligible:

### 2.1. Reforestation

This protocol applies to forest offset projects that restore tree cover on land that is not at optimal stocking levels and has minimal short-term (30-years) commercial opportunities.

(a) To be eligible under this protocol, a reforestation project must involve tree planting or removal of impediments to natural reforestation, on land that:

(1) Has had less than 10 percent tree canopy cover for a minimum of 10 years; or

(2) Has been subject to a significant disturbance that resulted in a loss of at least 20 percent of the land's above-ground standing live tree biomass.

(b) To be eligible under this protocol, a reforestation project must not:

(1) Involve rotational harvesting of reforested trees or any harvesting of pre-existing carbon in live trees during the first 30 years after offset project commencement unless such harvesting is needed to prevent or reduce an imminent threat of disease. Such harvesting may only occur if the Offset

Project Operator or Authorized Project Designee provides a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the harvesting is necessary to prevent or mitigate disease; and

(2) Undertake tree planting or removal of impediments to natural reforestation if the tree planting or removal activity follows a commercial harvest of healthy live trees within the Project Area that has occurred within the past 10 years or since the occurrence of a significant disturbance, whichever period is shorter.

(c) The project area for a reforestation project:

(1) May be situated on either private or public lands, excluding federal lands that are not included in the categories of land listed in subchapter 3.2(f) of this protocol;

(2) May have boundaries that are not finalized until the completion of its second full verification. The boundary that is set shall be the Project Area boundary for the duration of the project, provided that:

(A) All lands included in the project area were initially included in the project area during listing; and

(B) The project has elected to defer its initial inventory until the second full verification;

(3) Can be contiguous or separated into tracts;

(4) May extend across multiple assessment areas within an ecosection or supersection, but may not extend across more than two adjacent ecosections or supersections as identified in the supersection maps available from the Forest Offset Protocol Resources section of ARB's website; and

(5) May not include land that is subject to a conservation easement with federal holders.

### 2.2. Improved Forest Management

This protocol applies to forest offset projects that involve management activities that maintain or increase carbon stocks on forested land relative to baseline levels of carbon stocks as defined in subchapter 5.2 of this protocol.

(a) Eligible management activities may include, but are not limited to:
    (1) Increasing the overall age of the forest by increasing rotation ages;
    (2) Increasing the forest productivity by thinning diseased and suppressed trees;
    (3) Managing competing brush and short-lived forest species;
    (4) Increasing the stocking of trees on understocked areas; and/or
    (5) Maintaining stocks at a high level.

(b) The project area for an improved forest management project:
    (1) Must be finalized by the conclusion of the initial verification;
    (2) May be situated on either private or public lands, excluding federal lands that are not included in the categories of land listed in subchapter 3.2(f) of this protocol;
    (3) Must be situated on land that has greater than 10 percent tree canopy cover;
    (4) May define geographic boundaries such that non-forested areas or areas not under forest management are excluded from the project area;
    (5) Can be contiguous or separated into tracts;
    (6) May extend across multiple assessment areas within an ecosection or supersection, but may not extend across more than two adjacent ecosections or supersections as identified in the supersection maps available from the Forest Offset Protocol Resources section of ARB's website; and
    (7) May not include land that is subject to a conservation easement with federal holders.

### 2.3. Avoided Conversion

This protocol applies to forest offset projects that involve preventing the conversion of forestland to a non-forest land use by dedicating the land to continuous forest cover

through a qualified conservation easement or transfer to public ownership, excluding transfer to federal ownership.

(a) To be eligible under this protocol, an avoided conversion project must:
    (1) Take place on lands that are privately owned prior to offset project commencement; and
    (2) Demonstrate that there is a significant threat of conversion of project land to a non-forest land use by following the requirements for establishing the project's baseline in subchapter 5.3 of this protocol.

(b) The project area:
    (1) Must be finalized by the conclusion of the initial verification;
    (2) Must be situated on private land, unless the land is transferred to public ownership as part of the project;
    (3) Must be entirely covered by a qualified conservation easement or entirely transferred to public ownership;
    (4) Must be defined through the required appraisal process;
    (5) Must be determined according to the following boundary definitions based on the type of anticipated conversion:
        (A) Residential – The boundary of the parcel or parcels that have been appraised as having a "higher and better use" in residential development;
        (B) Agricultural production or mining – The boundary of the parcel or parcels that have been appraised as having a "higher and better use" in agricultural production or mining;
        (C) Recreation – The boundary of the parcel or parcels that have been appraised as having a "higher and better use" as recreation, including forested areas within 200 feet of fairways, greens, and buildings where conversion to a golf course is anticipated; and
        (D) Commercial or industrial buildings – The boundary of the parcel or parcels that have been appraised as having a "higher and better use" as commercial or industrial buildings, including forested areas within 200 feet of suitable building sites;
    (6) Can be contiguous or separated into tracts;

(7) May extend across multiple assessment areas within an ecosection or supersection, but may not extend across more than two adjacent ecosections or supersections as identified in the supersection maps available from the Forest Offset Protocol Resources section of ARB's website; and

(8) May not include land that is subject to a conservation easement with federal holders.

## Chapter 3. Eligibility

In addition to the offset project eligibility criteria and regulatory program requirements set forth in subarticle 13 of the Regulation, forest offset projects must adhere to the eligibility requirements below.

### 3.1. General Eligibility Requirements

(a) In order to be eligible under this protocol, a forest offset project must:

(1) Meet the natural forest management criteria set forth in table 3.1;

**Table 3.1. Natural Forest Management Criteria for Forest Offset Projects**

| Natural Forest Management Criteria | Assessment | Timeline for Meeting Criteria |
|---|---|---|
| **Native Species** | | |
| Project consists of at least 95% native species based on the sum of carbon in standing live tree carbon stocks. The assessment must be conducted using estimates of stems per acre for reforestation projects and basal area per acre for improved forest management and avoided conversion projects.<br><br>Native species are identified under the heading "Associated Species" in the Assessment Area Data File (May 20, 2015, incorporated by reference) associated with this protocol version available on the Forest Offset Protocol Resources section of ARB's website.<br><br>If a state/regional reference cannot be obtained or is determined to be inadequate by the registered professional forester on the verification team, documentation from a state botanist or other qualified independent resource, recognized as expert by academic, private and government organizations, must be submitted indicating that the project promotes and maintains native forests. | Assessed at initial and all subsequent verifications from inventory data.<br><br>Reforestation projects as qualified in subchapter 5.1.1(b)(2) may defer assessment until the submission of the Offset Project Data Report that will undergo the second site-visit verification. | Project must demonstrate continuous progress towards meeting requirement and must meet criterion within 25 reporting periods.<br><br>Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved within 25 reporting periods.<br><br>Projects must continue to meet requirement for the duration of the project life. |

| Composition of Native Species | | |
|---|---|---|
| **Reforestation Projects**<br>To the extent seed is available, and/or physical site characteristics permit, reforestation projects that involve planting of seedlings must plant a mixture of species such that no single species' prevalence, measured as the percent of all live tree stems in the project area, exceeds the percentage value shown under the heading 'Species Diversity Index' in the Assessment Area Data File associated with this protocol version available on the Forest Offset Protocol Resources section of ARB's website.<br><br>Where seed is unavailable, the reforestation project is based on natural regeneration, or physical site characteristics are limiting, a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that seed is unavailable, the reforestation project is based on natural regeneration, or physical site characteristics are limiting must be submitted.<br><br>**Improved Forest Management and Avoided Conversion Projects**<br>Where the project area naturally consists of a mixed species distribution, no single species' prevalence, measured as the percent of the basal area of all live trees in the project area, exceeds the percentage value of standing live tree carbon shown under the heading "Species Diversity Index" in the Assessment Area Data File associated with this protocol version available on the Forest Offset Protocol Resources section of ARB's website.<br><br>Where the project area does not naturally consist of a mixed species distribution, a written statement from the government agency in charge of forestry regulation in the state where the project is located stipulating that the project area does not naturally consist of a mixed species distribution must be submitted.<br><br>**All Project Types**<br>Where supported by scientific peer-reviewed research, the planting of native species outside of their current distribution is allowed as an adaptation strategy due to climate change. Such planting must be done in accordance with a state- or federally-approved adaptation plan, or a local plan that has gone through a transparent public review process. A written statement must be submitted from the government agency in charge of forestry regulation in the state where the project is located stipulating that the planting of native trees outside their current range is appropriate as an adaptation to climate change. | Assessed at initial and all subsequent verifications from inventory data.<br><br>Reforestation projects as qualified in subchapter 5.1.1(b)(2) may defer assessment until the submission of the Offset Project Data Report that will undergo the second site-visit verification. | Project must demonstrate continuous progress towards meeting requirement and must meet criterion within 25 reporting periods.<br><br>Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved within 25 reporting periods.<br><br>Projects must continue to meet requirement for the duration of the project life. |
| **Distribution of Age Classes/Sustainable Management** | | |
| All forest landholdings within geographic areas eligible under this protocol (the contiguous United States and | Criterion applies at first | Project must meet requirement at all times |

| | | |
|---|---|---|
| eligible portions of Alaska identified on the map available from the Forest Offset Protocol Resources section of ARB's website), including the project area, owned or controlled by the forest owner(s) and its affiliates (as defined in subchapter 3.1(a)(2)) are currently under one or a combination of the following:<br><br>1. Third-party certification under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System, whose certification standards require adherence to and verification of harvest levels which can be permanently sustained over time, or<br><br>2. Operating under a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency, or<br><br>3. The forest owner(s) must employ uneven-aged silvicultural practices and canopy retention averaging at least 40 percent across the forest, as measured on all contiguous 20 acre areas within the entire forestland owned by the forest owner(s), including land within and outside of the project area. (Areas impacted by Significant Disturbance may be excluded from this test.) | commercial harvest and is assessed during each subsequent verification | during the project life upon initiating first regeneration or commercial harvest. |
| If even-aged management is practiced, on a watershed scale up to 10,000 acres (or the project area, whichever is smaller), projects must maintain no more than 40 percent of their forested acres in ages less than 20 years. (Areas impacted by Significant Disturbance may be excluded from this test.) | Assessed at initial and all subsequent site visit verifications | Project must demonstrate continuous progress towards meeting requirement and must meet criterion within 25 reporting periods.<br><br>Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved within 25 reporting periods.<br><br>Projects must continue to meet requirement for the duration of the project life. |
| **Structural Elements (Standing and Lying Dead Wood)** | | |
| **For portions of the project area that have not recently undergone salvage harvesting:**<br>If a verifier determines that the quantity of lying dead wood is commensurate with recruitment from standing dead trees (i.e., there is no evidence that lying dead wood has been actively removed), the project must maintain (or demonstrate ongoing progress toward) an average of at least:<br>▪ one (1) metric ton of carbon (C) per acre; or<br>▪ 1% of standing live tree carbon stocks, in *standing* dead tree carbon stocks, whichever is higher.<br><br>If a verifier determines that the quantity of lying dead wood is **not** commensurate with recruitment from standing dead | Assessed during initial and all subsequent verifications from inventory data, observations from site visits and/or other verification activities.<br><br>Reforestation | **Portions of the project area that have not recently undergone salvage harvesting** must demonstrate continuous progress towards meeting requirement and must meet criterion within 25 reporting periods.<br><br>Project is not eligible unless it is demonstrated that management activities will enable this goal to be achieved within 25 reporting |

| | | |
|---|---|---|
| trees (i.e., it appears lying dead wood has been actively removed), the project must maintain (or demonstrate ongoing progress toward) an average of at least:<br>▪ two (2) metric tons of carbon (C) per acre; or<br>▪ 1% of standing live tree carbon stocks, in *standing* dead tree carbon stocks, whichever is higher.<br><br>Standing dead tree carbon stocks may be evenly or unevenly distributed throughout the portion of the project area unaffected by salvage harvesting, as long as the appropriate minimum average tonnage per acre requirement is met.<br><br>**For portions of the project area that have undergone salvage harvesting within the previous reporting period:**<br>If a verifier determines that the quantity of lying dead wood following salvage harvest is commensurate with recruitment from standing dead trees, the project must maintain (or demonstrate ongoing progress toward) an average of at least two (2) metric tons of carbon (C) per acre in *standing* dead tree carbon stocks.<br><br>If a verifier determines that the quantity of lying dead wood following harvest is **not** commensurate with recruitment from standing dead trees, the project must maintain (or demonstrate ongoing progress toward) an average of at least four (4) metric tons of carbon (C) per acre in *standing* dead tree carbon stocks.<br><br>Standing dead tree carbon stocks may be evenly or unevenly distributed throughout the portion of the project area subject to salvage harvesting, as long as the appropriate minimum average tonnage per acre requirement is met. | projects as qualified in subchapter 5.1.1(b)(2) may defer assessment until the submission of the Offset Project Data Report that will undergo the second site-visit verification. | periods.<br><br>Projects must continue to meet requirement for the duration of the project life.<br><br>**Portions of the project area that have undergone salvage harvesting within the previous reporting period** must continue to meet those requirements for a period of 30 reporting periods following the salvage harvest. After 30 reporting periods, the portion of the project area subject to salvage harvesting must meet the requirements for portions that have not recently undergone salvage harvesting.<br><br>Projects must continue to meet requirement for the duration of the project life. |

(2) When a harvest plan is submitted to a state or federal agency or when commercial harvesting is initiated, the Offset Project Operator or Authorized Project Designee must demonstrate that sustainable harvesting practices are employed on all forest landholdings within the geographic areas eligible under this protocol (the contiguous United States and eligible portions of Alaska identified on the map available from the Forest Offset Protocol Resources section of ARB's website), including the project area, that are owned or controlled by the forest owner(s) and its affiliates;

(A) For the purposes of the sustainable harvesting practices requirements, an affiliate means any person or entity that, directly or indirectly through one or more intermediaries, controls, is controlled by, or is under common control by the forest owner(s) where the forest

owner(s) has greater than 50 percent interest, including any general or limited partnership in which the forest owner(s) is a partner and any limited liability company in which the forest owner(s) holds more than 50 percent of the voting ownership. For the purposes of this definition, "control" means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a person, whether through the ownership of voting securities, by contract or otherwise. For the purposes of this definition, “person” means an individual or a general partnership, limited partnership, corporation, professional corporation, limited liability company, limited liability partnership, joint venture, trust, business trust, cooperative or association or any other legally-recognized entity;

(B) If a forest owner or affiliate acquires new forest landholdings during the project life, the land must be incorporated under the certification or management plan within 5 years of acquisition;

(C) Sustainable long-term harvesting practices must be demonstrated through one or a combination of the following options:

1. The forest owner(s) must be certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System certification programs. The terms of certification must require adherence to and verification of harvest levels which can be permanently sustained over time;
2. The forest owner(s) must adhere to a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency; or
3. The forest owner(s) must employ uneven-aged silvicultural practices (if harvesting occurs) on all of the forest owner’s landholdings within the assessment area containing the project and maintain canopy cover averaging at least 40 percent across all of the forest owner’s landholdings within the assessment area containing the project as measured on contiguous 20 acre areas

within the forest owner's landholdings found in any of these assessment areas, including land within and outside of the project area (areas impacted by significant disturbance may be excluded from this test);

(3) Maintain or increase standing live tree carbon stocks within the project area over any 10 consecutive year period during the project life except as allowed for in subchapter 3.1(b)(1);

(4) If the project employs even-aged management practices within the project area, it must meet the following harvest unit size and buffer area requirements:

(A) Even-aged harvest units must not exceed 40 acres in total area;

(B) Even-aged harvest units shall be separated by an area that is at least as large as the area being harvested or 20 acres, whichever is less, and shall be separated by at least 300 ft. in all directions;

(C) Within ownership boundaries, no area contiguous to an even-aged harvest unit may be harvested using an even-aged harvest method unless the average of the dominant and codominant trees on an acceptably stocked prior even-aged harvest unit is at least five feet tall, or at least five years of age from the time of establishment on the site, either by the planting or by natural regeneration. If these standards are to be met with trees that were present at the time of the harvest, there shall be an interval of not less than five years following the completion of operations before adjacent even-aged management may occur;

(D) An area on which even-aged timber operations have taken place shall be classified as acceptably stocked if either of the standards set forth in 1. or 2. below are met:

1. An area contains an average point count of 150 per acre that meets the requirements of subchapter 8.1(b)(2)(E) to be computed as follows:

a. Each countable tree which is not more than 4 inches DBH counts 1 point;

b. Each countable tree over 4 inches and not more than 12 inches DBH counts 3 points; and

c. Each countable tree over 12 inches DBH counts as 6 points.

2. The average residual basal area measured in stems 1 inch or larger in diameter is at least 50 square feet per acre; and

(E) Cuts on harvest units that occurred prior to the project commencement date are exempt from subchapters 3.1(a)(4)(A) and 3.1(a)(4)(B) provided that no new harvests occur in the previously cut harvest unit or would-be buffer area until the harvest unit cut prior to project commencement meets the requirements of subchapter 3.1(a)(4)(A) and 3.1(a)(4)(B); and

(5) If project lands were included in a carbon offset project in a voluntary offset program other than one of the approved early action offset quantification methodologies:

(A) Demonstrate that it has met all legal and contractual requirements to allow it to terminate its project relationship with the voluntary offset program and be listed using this compliance offset protocol;

(B) Demonstrate that all credits issued or to be issued under the voluntary offset program have been actualized prior to the compliance project start date; and

(C) Determine a baseline per the requirements of the protocol that incorporates the management practices, constraints and resulting forest conditions, at the time the offset project transitions to the Compliance Offset Protocol, as a result of participating in the voluntary offset program.

(b) To be eligible under this protocol, a forest offset project must not:

(1) Experience a decrease in the standing live tree carbon stocks over any 10 consecutive year period, as evaluated in the first reporting period that is at least ten years after project commencement and every subsequent reporting period, by comparing the current reporting period's 10-year average carbon stocks to the previous reporting period's 10-year average

carbon stocks, except if the decrease in standing live tree carbon stocks is due to one of the following causes:[2]

(A) The decrease is demonstrably necessary to substantially improve the project area's resistance to wildfire, insect, and/or disease risks where:

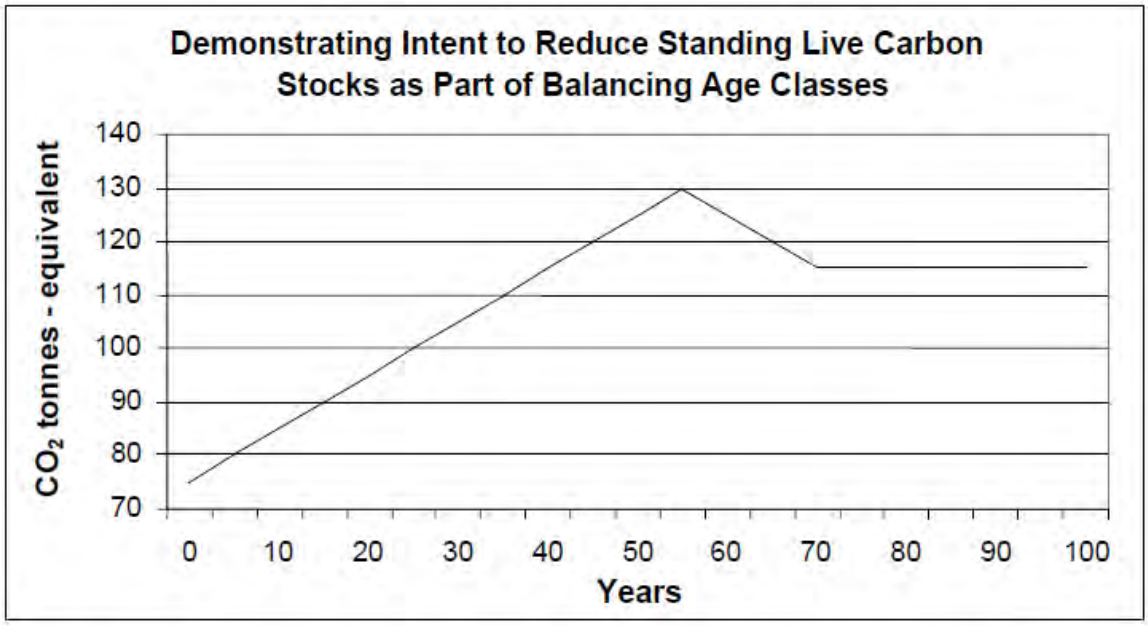
1. The actions that will be taken to reduce the risks are documented; and
2. The techniques used to improve resistance are supported by relevant published peer reviewed research;

(B) The decrease is associated with a planned balancing of age classes (regeneration, sub-merchantable, and merchantable) and is detailed in a long-term management plan that demonstrates harvest levels can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency where:

1. Documentation is submitted at the time of the forest project's listing, indicating that a balancing of age classes, resulting in a decrease in the standing live tree carbon stocks, is planned at the initiation of the forest project (figure 3.1);
2. At no time over the project life does the forest project's inventory of standing live tree carbon stocks fall below the forest project's baseline standing live tree carbon stocks, or 20 percent less than the forest project's standing live tree carbon stocks at the project's initiation, whichever is higher; and
3. Over any 10 consecutive year period, average standing live tree carbon stocks are maintained at or above the standing live tree carbon stocks at the initiation of the project;

[2] These exceptions in no way change or affect the requirements related to compensating for reversals as detailed in subchapter 3.5.3.

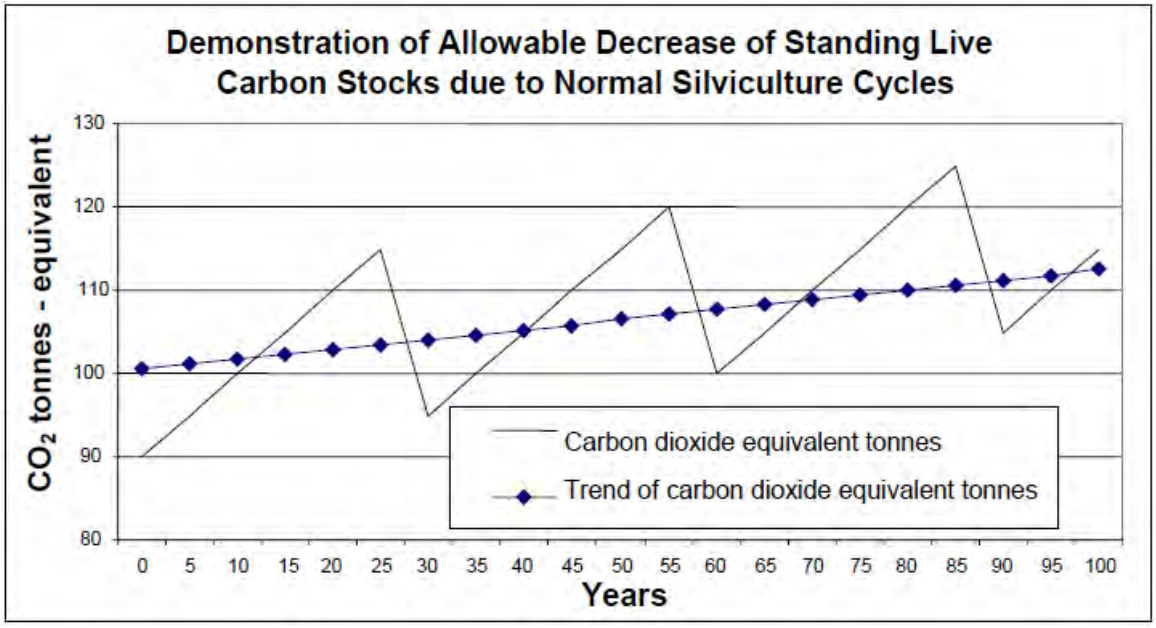
**Figure 3.1. Example of Reducing Standing Live Tree Carbon Stocks as Part of Balancing Age Classes**




(C) The decrease is part of normal silviculture cycles for forest ownerships less than 1,000 acres where periodic harvests remove more biomass than the biomass growth over the past several years where:

1. At no time during the project life does the forest project's inventory of standing live tree carbon stocks fall below the forest project's baseline standing live tree carbon stocks, or 20 percent less than the forest project's standing live tree carbon stocks at the project's initiation, whichever is higher;
2. Over any 10 consecutive year period, average standing live tree carbon stocks are maintained at or above the standing live tree carbon stocks at the initiation of the project; and
3. Documentation submitted at the time the forest project is listed indicates that fluctuations in the forest project's standing live tree carbon stocks are an anticipated silvicultural activity and that the overall trend will be for standing live tree carbon stocks to increase or stay the same over the life of the offset project (figure 3.2);

**Figure 3.2. Example of Allowable Decrease of Standing Live Tree Carbon Stocks due to Normal Silviculture Cycles**




(D) The decrease is due to an unintentional reversal; or

(E) The decrease in standing live tree carbon stocks occurs after the final crediting period (during the required 100 year monitoring period) and the residual live carbon stocks are maintained at a level that assures all credited standing live tree carbon stocks are permanently maintained;

(2) Experience a decrease in standing live tree carbon stocks that results in the standing live tree carbon stocks falling below the forest project's baseline standing live tree carbon stocks or 20 percent less than the forest project's standing live tree carbon stocks at the project's initiation, whichever is higher;

(3) Employ broadcast fertilization; and

(4) Take place on land that was part of a previously listed compliance offset forest project, unless the previous forest project was terminated due to an unintentional reversal or is an early action offset project transitioning to this protocol according to the provisions of the Regulation and this protocol.

(c) Offset Project Operators or Authorized Project Designees that use this protocol must:

(1) Provide the listing information required by section 95975 of the Regulation and subchapter 7.1 of this protocol;
(2) Monitor GHG emission sources, sinks, and reservoirs within the offset project boundary as delineated in chapter 4 per the requirements of chapter 6;
(3) Quantify GHG emission reductions and GHG removal enhancements per chapter 5;
(4) Prepare and submit OPDRs for each reporting period that include the information requirements in subchapter 7.2 of this protocol; and
(5) Obtain offset verification services from an ARB-accredited offset verification body in accordance with section 95977 of the Regulation and chapter 8 of this protocol.

### 3.2. Location

(a) Only projects located in the United States are eligible under this protocol.
(b) Forest projects in Alaska are restricted to geographic areas identified on the map available from the Forest Offset Protocol Resources section of ARB's website.
(c) Forest projects in Hawaii are not eligible at this time due to lack of region-specific data.
(d) All forest projects on public lands must be approved by the government agency or agencies responsible for management activities on the land. This approval must include an explicit approval of the forest project's baseline, as determined in chapter 5, and must involve any public vetting processes necessary to evaluate management and policy decisions concerning the project activity.
(e) Forest projects on federal lands that are not included in the categories of land listed in subchapter 3.2(f) are not eligible at this time.
(f) Forest projects situated on the following categories of land are only eligible under this protocol if they meet the requirements of this protocol and the Regulation, including the waiver of sovereign immunity requirements of section 95975(l) of the Regulation:
    (1) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

(2) Land that is “Indian lands” of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

(3) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands.

### 3.3. Offset Project Operator or Authorized Project Designee

(a) The Offset Project Operator or Authorized Project Designee is responsible for project listing, monitoring, reporting, and verification.

(b) The Offset Project Operator or Authorized Project Designee must submit the information required by subarticle 13 of the Regulation and by chapter 7.

(c) The Offset Project Operator must have the legal authority to implement the offset project.

(d) The Offset Project Operator may identify an Authorized Project Designee pursuant to section 95974 of the Regulation, to assist or consult with implementation of the forest project.

(e) A single forest owner must be identified as the Offset Project Operator. If there are multiple forest owners, all forest owners are ultimately responsible for all forest project commitments.

(f) All information submitted to ARB or an Offset Project Registry must reference the Offset Project Operator and all forest owner(s) who are ultimately responsible for the accuracy and completeness of the information submitted.

### 3.4. Additionality

Offset projects must meet the additionality requirements of section 95973(a)(2) of the Regulation, in addition to the requirements in this protocol. Eligible offsets must be generated by projects that yield additional GHG emission reductions or removal enhancements that exceed any GHG emission reductions or removal enhancements otherwise required by law or regulation or any GHG emission reductions or removal enhancements that would otherwise occur in a conservative business-as-usual scenario. These requirements are assessed through the Legal Requirement Test in subchapter 3.4.1 and the Performance Standard Evaluation in subchapter 3.4.2 of this protocol.

### 3.4.1. Legal Requirement Test

(a) Emission reductions or removals enhancements achieved by a forest project must exceed those required by any law, regulation, or other legally binding mandate as required in sections 95973(a)(2)(A) and 95975(k) of the Regulation.

(b) Legally binding mandates may include, but are not limited to:

  (1) Management plans such as Timber Harvest Plans that are required for government agency approval of harvest activities; and

  (2) Conservation easements or deed restrictions, except where such conservation easements have been enacted within one year of offset project commencement in support of the forest project.

(c) The legal requirement test is satisfied if:

  (1) Project activities are not legally required (as defined in subchapter 3.4) at the time of offset project commencement; and

  (2) Modeling of the forest project's baseline carbon stocks reflects all legal constraints (as required in subchapter 5 and appendix B).

  (3) Avoided conversion projects submit official documentation demonstrating that the type of anticipated land use conversion is legally permissible. Such documentation must fall into at least one of the following categories:

    (A) Documentation indicating that the current land use policies, including zoning and general plan ordinances, and other local and state statutes and regulations, permit the anticipated type of conversion;

    (B) Documentation indicating that the forest owner(s) obtained all necessary approvals from the governing county to convert the project area to the proposed type of non-forest land use (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.); or

    (C) Documentation indicating that similarly situated forestlands within the project's assessment area were recently able to obtain all necessary approvals from the governing county, state, or other governing agency to convert to a non-forest land use (including, for instance, certificates

of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.).

### 3.4.2. Performance Standard Evaluation

(a) Emission reductions or removals enhancements achieved by a forest project must exceed those likely to occur in a conservative business-as-usual scenario.

(b) The performance standard evaluation is satisfied if the following requirements are met, on the basis of project type:

(1) Reforestation projects

(A) A reforestation project that occurs on land that has had less than 10 percent tree canopy cover for at least 10 years automatically satisfies the performance standard evaluation.

(B) A reforestation project that occurs on land that has undergone a significant disturbance satisfies the performance standard evaluation if:

1. The forest project corresponds to a scenario in appendix E, table E.1, indicating that it is “eligible” (as determined by the requirements and methods in appendix E); or
2. The forest project occurs on a type of land for which the forest owner(s) has not historically engaged in or allowed timber harvesting.

(2) Improved forest management projects

(A) An improved forest management project automatically satisfies the performance standard evaluation.

(B) Improved forest management project activities are considered additional to the extent they produce GHG emission reductions and GHG removal enhancements in excess of those that would have occurred under a conservative business-as-usual scenario, as defined by the baseline estimation requirements in subchapter 5.2.

(3) Avoided conversion projects

(A) An avoided conversion project satisfies the performance evaluation standard if a real estate appraisal for the project area is submitted indicating that the project area is suitable for conversion and that the

alternative land use for the project area has a higher market value than forestland. The appraisal must:

1. Clearly identify the highest value alternative land use for the project area;
2. Indicate how the physical characteristics of the project area are suitable for the alternative land use;
    a. Where conversion to commercial, industrial, residential, or agricultural land uses is anticipated, the appraisal must indicate that the average slope across the entire project area does not exceed 40 percent;
    b. Where conversion to agricultural land use is anticipated, the appraisal must provide evidence of soil suitability for the type of expected agricultural land use and evidence of water availability for the type of expected agricultural land use;
    c. Where conversion to mining land use is anticipated, the appraisal must provide evidence of the extent and amount of mineral resources existing in the project area, and the commercial viability of mineral extraction;
3. Identify specific portions of the project area suitable for the identified alternative land use;
4. Where conversion to residential, commercial, industrial or recreational land uses is anticipated, the appraisal must also describe:
    a. The proximity of the project area to metropolitan areas;
    b. The proximity of the project area to grocery and fuel services; and accessibility of those services; and
    c. The population growth within 180 miles of the project area;
5. Include any and all costs and revenues associated with the conversion that are necessary to get the property to the higher and better use condition; these costs and revenues would therefore already be included in the appraisal value of the alternative land use;

6. Demonstrate that the fair market value of the anticipated alternative land use for the project area is at least 40 percent greater than the value of the current forested land use; and
7. Projects with multiple parcels within a project area must meet the requirement that the alternative land use for each parcel has at least a 40 percent greater value than the current forested land use. Individual parcels cannot be averaged for eligibility purposes. The Offset Project Operator or Authorized Project Designee must sum the individual appraised values for each parcel within the project area when calculating the ACD.

(B) The appraisal must be conducted in accordance with the Uniform Standards of Professional Appraisal Practice[3] and the appraiser must meet the qualification standards outlined in Internal Revenue Code, Section 170 (f)(11)(E)(ii).[4]

### 3.5. Permanence

(a) The Regulation requires that credited GHG emission reductions and GHG removal enhancements be "permanent." For purposes of this protocol, 100 years is considered permanent.

(b) Permanence of forest project GHG emission reductions and removal enhancements is addressed through three mechanisms:

(1) The requirement for all offset projects to monitor onsite carbon stocks, submit annual Offset Project Data Reports, and undergo third-party verification of those reports with site visits at least every six years for the duration of the project life;

[3] Uniform Standards of Professional Appraisal Practice. http://www.uspap.org/#/1/.

[4] Section 170 (f)(11)(E)(ii) of the Internal Revenue Code defines a qualified appraiser as "an individual who -
(I) has earned an appraisal designation from a recognized professional appraiser organization or has otherwise met minimum education and experience requirements set forth in regulations prescribed by the Secretary,
(II) regularly performs appraisals for which the individual receives compensation, and
(III) meets such other requirements as may be prescribed by the Secretary in regulations or other guidance."

(2) The regulatory obligation for all intentional reversals of GHG emission reductions and GHG removal enhancements to be compensated for through retirement of other compliance instruments; and

(3) The maintenance of a forest buffer account by ARB to provide insurance against reversals of GHG emission reductions and GHG removal enhancements due to unintentional causes.

### 3.5.1. Project Life and Minimum Time Commitment

(a) Forest projects must continue to monitor, report, and verify offset project data for the duration of the project life.

(b) There are three possible exceptions to this minimum time commitment:

(1) A forest project automatically terminates if an unintentional reversal occurs that reduces the forest project's standing live tree carbon stocks below the forest project's baseline standing live tree carbon stocks. If this occurs, the requirements of section 95983 of the Regulation apply;

(2) A forest project automatically terminates if project lands or timber rights are sold to an entity that does not elect to take over the forest project responsibilities and commitments. Such a termination will require a quantity of ARB offset credits to be retired, as specified in subchapter 3.5.3; or

(3) A forest project may be voluntarily terminated prior to the end of its minimum time commitment if the required quantities of compliance instruments are retired, as specified as specified in subchapter 3.5.3.

### 3.5.2. Identifying a Reversal

(a) GHG emission reductions and GHG removal enhancements can be reversed if the stored carbon associated with them is released (back) to the atmosphere.

(b) Provisions related to the disposition of a forest project after a reversal are set forth in section 95983 of the Regulation. These provisions dictate under what circumstances a forest project that undergoes an intentional or unintentional reversal would be terminated and under what circumstances the forest project may continue without termination.

(c) To determine if a reversal has occurred, equation 3.1 must be applied.

**Equation 3.1. Identifying a Reversal**

Evaluate: $(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,\,y} - BC_{wp,\,y}) * 0.80 + SE_y$

*Where,*

| | | |
|---|---|---|
| $\Delta AC_{onsite}$ | = | The change in actual onsite carbon since the last reporting period ($MTCO_2e$) |
| $\Delta BC_{onsite}$ | = | The change in baseline onsite carbon since the last reporting period (MT $CO_2e$)<br>For improved forest management projects, where baseline onsite carbon stocks are averaged across all reporting periods, the value for $\Delta BC_{onsite}$ will be zero in all reporting periods except the first reporting period of the project. |
| $AC_{wp,y}$ | = | Actual carbon in wood products produced in reporting period y that is projected to remain stored for at least 100 years (i.e., $WP_{total,\,y}$ derived for actual harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| $BC_{wp,y}$ | = | Averaged annual baseline carbon in wood products that would have remained stored for at least 100 years (i.e., $WP_{total,\,y}$ derived for baseline harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| *0.80* | = | Market responses to changes in wood product production. The general assumption in this protocol is that for every ton of reduced harvesting caused by a forest project, the market will compensate with an increase in harvesting of 0.2 tons on other lands. |
| $SE_y$ | = | Secondary effect GHG emissions caused by the project activity in reporting period y (MT $CO_2e$) |
| *y* | = | Reporting period |

*With:*

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

*Where,*

| | | |
|---|---|---|
| $AC_{onsite,y}$ | = | Actual onsite carbon as inventoried at the end of the reporting period y (MT $CO_2e$) |
| $AC_{onsite,y-1}$ | = | Actual onsite carbon as inventoried at the end of the reporting period y-1 (MT $CO_2e$)<br>If y is the first reporting period of the offset project, the value for $AC_{onsite,y-1}$ will be zero. |
| $CD_y$ | = | Appropriate confidence deduction for reporting period y, as determined in appendix A (%) |
| $CD_{y-1}$ | = | Appropriate confidence deduction for reporting period y-1, as determined in appendix A (%) |

*And:*

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

*Where,*

| | | |
|---|---|---|
| $BC_{onsite,y}$ | = | Baseline onsite carbon as estimated at the end of the reporting period y (MT $CO_2e$) |

$BC_{onsite,y-1}$ = Baseline onsite carbon as estimated at the end of the reporting period y-1 (MT $CO_2e$)
If y is the first reporting period of the offset project, the value for $BC_{onsite,y-1}$ will be zero.

If the result is ≥ 0, then the forest project has generated GHG emission reductions and GHG removal enhancements in the reporting period

If the result is < 0 and ARB or registry credits have previously been issued to the forest project, then a reversal has occurred, regardless of the cause of the decrease

If the result is < 0 and no ARB or registry credits have been issued to the forest project since its commencement date, then the result is treated as a "negative carryover" to GHG emission reduction calculations in subsequent reporting periods (variable $N_{y-1}$ within equation 5.1)

### 3.5.3. Compensating for a Reversal

(a) Requirements for compensating for unintentional reversals are set forth in section 95983 of the Regulation. Unintentional reversals are insured against by a forest buffer account, a holding account administered by ARB for ARB offset credits issued to forest projects.

(1) All forest projects must contribute a percentage of ARB offset credits to the Forest Buffer Account any time ARB offset credits are issued by ARB for verified GHG emission reductions and GHG removal enhancements. Each forest project's contribution is based on a project-specific risk rating, determined according to appendix D.

(2) If a forest project experiences an unintentional reversal of credited GHG emission reductions and GHG removal enhancements, ARB offset credits from the forest buffer account will be retired in an amount equal to the total amount of carbon that was reversed (measured in metric tons of $CO_2e$) according to the process identified in the Regulation.

(b) Requirements for compensating for intentional reversals are set forth in section 95983 of the Regulation. If a forest project is terminated for any reason except an unintentional reversal, the forest owner(s) must replace any ARB offset credits that have previously been issued based on the requirements in the Regulation and the following provisions:

(1) For a reforestation or avoided conversion project, a quantity of compliance instruments equal to the total number of ARB offset credits issued to the project over all preceding reporting periods must be retired; and

(2) For an improved forest management project, a quantity of compliance instruments equal to the total number of ARB offset credits issued and, where applicable, all early action offset credits issued pursuant to section 95990(i) of the Regulation to the project over all preceding reporting periods, multiplied by the appropriate compensation rate indicated in table 3.2, must be retired.

**Table 3.2. Compensation Rate for Terminated Improved Forest Management Projects**

| Number of years that have elapsed between offset project commencement and the date of termination | Compensation Rate |
|---|---|
| 0-5 | 1.40 |
| >5-10 | 1.20 |
| >10-20 | 1.15 |
| >20-25 | 1.10 |
| >25-50 | 1.05 |
| >50 | 1.00 |

### 3.6. Offset Project Commencement

(a) For this protocol, offset project commencement is defined as the date on which the earliest activity is first implemented that will lead to increased GHG emission reductions or GHG removal enhancements relative to the forest project's baseline. Only the following actions identify offset project commencement on the basis of project type:

(1) For a reforestation project, whichever of the following actions occurs first denotes an offset project commencement date:

(A) Planting trees;

(B) Removing impediments to natural regeneration; or

(C) Initiating site preparation for the planting of trees.

(2) For an improved forest management project, one of the following actions must denote an offset project commencement date:

(A) Submitting the offset project listing information specified in subchapter 7.1.

(B) Transferring of property ownership to a public or private entity; or

(C) Recordation of a conservation easement on the project area;

1. The recordation of a conservation easement may be used to denote the commencement date of pre-existing projects between December 31, 2006 and December 31, 2010.
2. Any previously recorded conservation easement may only be considered a Qualified Conservation Easement if it was recorded within one year prior to the identified project commencement date.
3. Any previously recorded conservation easement must still meet, or be modified to meet, all of the requirements contained in the definition in subchapter 1.2 in order to be considered "qualified."

(3) For an avoided conversion project, the action is committing the project area to continued forest management and protection through recording a conservation easement with a provision to maintain the project area in forest cover or transferring the project area to public ownership.

(b) Adequate documentation denoting the offset project commencement date must include, where applicable, deeds of trust, title reports, conservation easement documentation, dated forest management plans, and/or other relevant contracts or agreements.

(c) Pursuant to section 95973(a)(2)(B) of the Regulation, compliance offset projects must have an offset project commencement date after December 31, 2006.

### 3.7. Project Crediting Period

(a) The offset project crediting period is the period of time over which emission reductions are quantified for the purpose of determining creditable GHG emission reductions.

(b) The offset project crediting period for this protocol is 25 reporting periods.

(c) For this protocol, the initial crediting period begins on the first day of the first reporting period as identified in the first verified Offset Project Data Report received by ARB or an Offset Project Registry approved pursuant to section 95986 of the Regulation.

### 3.8. Regulatory Compliance

(a) An offset project must meet the regulatory compliance requirements set forth in section 95973(b) of the Regulation.

(b) The Offset Project Operator or Authorized Project Designee is required to disclose in writing to the verifier any and all instances of non-compliance with any legal requirement associated with the project lands.

## Chapter 4. Offset Project Boundary – Quantification Methodology

The GHG assessment boundary, or offset project boundary, delineates the GHG emission SSRs that must be included or excluded when quantifying the net changes in GHG emissions associated with the sequestration of carbon achieved by increasing and/or conserving forest carbon stocks. The following offset project boundaries apply to all forest projects on the basis of activity type:

### 4.1. Reforestation

(a) Table 4.1 lists the SSRs for reforestation projects indicating which gases are included or excluded from the offset project boundary.

(b) If an SSR is designated as a reservoir, GHG emission reductions and GHG removal enhancements are accounted for by quantifying changes in carbon stock levels. If an SSR is designated as a source or sink, GHG emission reductions and GHG removal enhancements are accounted for by quantifying changes in GHG emissions or GHG removal enhancement rates, as described in the table.

**Table 4.1. List of the Greenhouse Gas Sources, Sinks, and Reservoirs for Reforestation Projects**

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | |
| RF-1 | Standing live tree carbon (carbon in above- and below-ground portions of living trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by field measurements and updating forest carbon inventory |

| | | | | | |
|---|---|---|---|---|---|
| RF-2 | Shrubs and herbaceous understory carbon | Reservoir | $CO_2$ | Included/Excluded | Baseline: Pre-existing vegetation is modeled based on initial field inventory<br><br>Project: N/A. Carbon pool is excluded from project scenario. Removal of brush is quantified in secondary emissions |
| RF-3 | Standing dead tree carbon (carbon in all portions of dead, standing trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by updating forest carbon inventory |
| RF-4 | Lying dead wood carbon | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-6 | Soil carbon | Reservoir | $CO_2$ | Included/excluded: Soil carbon must be included in the Offset Project Boundary if any of the following occur:<br>▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds (or is expected to exceed from the baseline characterization and modeling) 25 percent of the project area over the project life, or<br>▪ Mechanical site preparation activities are not conducted on contours.<br>No crediting of increased soil carbon is allowed. | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by updating forest carbon inventory |
| RF-7 | Carbon in in-use forest products | Reservoir | $CO_2$ | Included | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |

| | | | | | |
|---|---|---|---|---|---|
| RF-8 | Forest product carbon in landfills | Reservoir | $CO_2$ | Excluded when project harvesting exceeds baseline.<br><br>Included when project harvesting is below baseline | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | |
| RF-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included: Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs | Baseline: N/A<br><br>Project: Quantified based on measured carbon stock changes in included reservoirs (SSRs #RF-2 and #RF-6) |
| RF-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Included | Baseline: N/A<br><br>Project: Estimated using default emission factors |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-11 | Mobile combustion emissions from ongoing project operation & maintenance | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-12 | Stationary combustion emissions from ongoing project operation & maintenance | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-13 | Biological emissions from clearing of forestland outside the project area | Source | $CO_2$ | Included | Baseline: N/A<br><br>Project: Estimated using default land-use conversion factors for non-project land |

| | | | | | |
|---|---|---|---|---|---|
| RF-14 | Biological emissions/ removals from changes in harvesting on forestland outside the project area | Source / Sink | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-15 | Combustion emissions from production, transportation, and disposal of forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| RF-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | Baseline: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #RF-7) and landfills (SSR #RF-8)<br><br>Project: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #RF-7) and landfills (SSR #RF-8) |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |

### 4.2. Improved Forest Management

(a) Table 4.2 lists the SSRs for improved forest management projects indicating which gases are included or excluded from the offset project boundary.

(b) If an SSR is designated as a reservoir, GHG emission reductions and GHG removal enhancements are accounted for by quantifying changes in carbon stock levels. If an SSR is designated as a source or sink, GHG emission reductions

and GHG removal enhancements are accounted for by quantifying changes in GHG emissions or GHG removal enhancement rates, as described in the table.

**Table 4.2. List of the Greenhouse Gas Sources, Sinks, and Reservoirs for Improved Forest Management Projects**

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | |
| IFM-1 | Standing live tree carbon (carbon in above- and below-ground portions of living trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by field measurements and updating forest carbon inventory |
| IFM-2 | Shrubs and herbaceous understory carbon | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-3 | Standing dead tree carbon (carbon in all portions of dead, standing trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by updating forest carbon inventory |
| IFM-4 | Lying dead wood carbon | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir | $CO_2$ | Excluded | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by updating forest carbon inventory |
| IFM-6 | Soil carbon | Reservoir | $CO_2$ | Included/ Excluded<br>Soil carbon must be included in the Offset Project Boundary, if any of the following activities occur:<br>▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds (or is expected to exceed from the baseline characterization and modeling) 25 percent of the project area over the project life, or | Baseline: Modeled based on initial field inventory measurements<br><br>Project: Measured by updating forest carbon inventory |

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| | | | | ▪ Mechanical site preparation activities are not conducted on contours.<br>No crediting of increased soil carbon is allowed. | |
| IFM-7 | Carbon in in-use forest products | Reservoir | $CO_2$ | Included | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |
| IFM-8 | Forest product carbon in landfills | Reservoir | $CO_2$ | Excluded when project harvesting exceeds baseline<br><br>Included when project harvesting is below baseline | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | |
| IFM-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included<br>Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs | Baseline: N/A<br><br>Project: Quantified based on measured carbon stock changes in included reservoirs (SSR #IFM-6, where applicable) |
| IFM-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-11 | Mobile combustion emissions from ongoing project operation & maintenance | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A. |
| IFM-12 | Stationary combustion emissions from ongoing project operation & | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| | maintenance | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-13 | Biological emissions from clearing of forestland outside the project area | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-14 | Biological emissions/ removals from changes in harvesting on forestland outside the project area | Source / Sink | $CO_2$ | Included / Excluded | Baseline: N/A<br><br>Project: Estimated using a default 20% “leakage” factor applied to the difference in harvest volume relative to baseline |
| IFM-15 | Combustion emissions from production, transportation, and disposal of forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| IFM-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | Baseline: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8)<br><br>Project: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #IFM-7) and landfills (SSR #IFM-8) |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |

### 4.3. Avoided Conversion

(a) Table 4.3 lists the SSRs for avoided conversion projects indicating which gases are included or excluded from the offset project boundary.

(b) If an SSR is designated as a reservoir, GHG emission reductions and GHG removal enhancements are accounted for by quantifying changes in carbon stock levels. If an SSR is designated as a source or sink, GHG emission reductions and GHG removal enhancements are accounted for by quantifying changes in GHG emissions or GHG removal enhancement rates, as described in the table.

**Table 4.3. List of the Greenhouse Gas Sources, Sinks, and Reservoirs for Avoided Conversion Projects**

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| **Primary Effect Sources, Sinks, and Reservoirs** | | | | | |
| AC-1 | Standing live tree carbon (carbon in above- and below-ground portions of living trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements and expected land-use conversion rates<br><br>Project: Measured by field measurements and updating forest carbon inventory |
| AC-2 | Shrubs and herbaceous understory carbon | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-3 | Standing dead tree carbon (carbon in all portions of dead, standing trees) | Reservoir | $CO_2$ | Included | Baseline: Modeled based on initial field inventory measurements and expected land-use conversion rates<br><br>Project: Measured by updating forest carbon inventory |
| AC-4 | Lying dead wood carbon | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-5 | Litter and duff carbon (carbon in dead plant material) | Reservoir | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-6 | Soil carbon | Reservoir | $CO_2$ | Included/ Excluded<br>Soil carbon must be included in the Offset Project Boundary, if any of the following activities occur:<br>▪ Site preparation activities involve deep ripping, furrowing, or | Baseline: Modeled based on initial field inventory measurements and expected land-use conversion rates<br><br>Project: Measured by updating forest carbon inventory |

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| | | | | plowing where soil disturbance exceeds (or is expected to exceed from the baseline characterization and modeling) 25 percent of the project area over the project life, or<br>▪ Mechanical site preparation activities are not conducted on contours<br>No crediting of increased soil carbon is allowed. | |
| AC-7 | Carbon in in-use forest products | Reservoir | $CO_2$ | Included | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |
| AC-8 | Forest product carbon in landfills | Reservoir | $CO_2$ | Excluded when project harvesting exceeds baseline<br><br>Included when project harvesting is below baseline | Baseline: Estimated from modeled harvesting volumes<br><br>Project: Estimated from measured harvesting volumes |
| **Secondary Effect Sources, Sinks, and Reservoirs** | | | | | |
| AC-9 | Biological emissions from site preparation activities | Source | $CO_2$ | Included<br>Biological emissions from site preparation are not quantified separately, but rather are captured by measuring changes in included carbon reservoirs | Baseline: N/A<br><br>Project: Quantified based on measured carbon stock changes in included reservoirs (SSR #AC-6, where applicable) |
| AC-10 | Mobile combustion emissions from site preparation activities | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-11 | Mobile combustion emissions | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| | from ongoing project operation & maintenance | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-12 | Stationary combustion emissions from ongoing project operation & maintenance | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-13 | Biological emissions from clearing of forestland outside the project area | Source | $CO_2$ | Included | Baseline: N/A<br><br>Project: Estimated using default forestland conversion factors |
| AC-14 | Biological emissions/ removals from changes in harvesting on forestland outside the project area | Source / Sink | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-15 | Combustion emissions from production, transportation, and disposal of forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| AC-16 | Combustion emissions from production, transportation, and disposal of alternative materials to forest products | Source | $CO_2$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A |

| SSR | Description | Type | Gas | Included/ Excluded | Quantification Method |
|---|---|---|---|---|---|
| AC-17 | Biological emissions from decomposition of forest products | Source | $CO_2$ | Included | Baseline: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #AC-7) and landfills (SSR #AC-8)<br><br>Project: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR #AC-7) and landfills (SSR #AC-8) |
| | | | $CH_4$ | Excluded | Baseline: N/A<br><br>Project: N/A |
| | | | $N_2O$ | Excluded | Baseline: N/A<br><br>Project: N/A<br>Decomposition of forest is not expected to be a significant source of $N_2O$ emissions. |

## Chapter 5. Quantifying GHG Emission Reductions and GHG Removal Enhancements – Quantification Methodology

(a) Offset Project Operators and Authorized Project Designees must use the activity type-specific quantification methods provided in this protocol to:

(1) Estimate baseline onsite carbon stocks;

(2) Estimate baseline carbon in harvested wood products;

(3) Determine actual onsite carbon stocks;

(4) Determine actual carbon in harvested wood products;

(5) Calculate the forest project's secondary effect; and

(6) Determine applicable confidence deductions and discount factors.

(b) The length of time over which GHG emission reductions are quantified is called the "reporting period". GHG emission reductions must be quantified over a consecutive twelve month period, except the first reporting period which may cover a period of 6 to 24 consecutive months as allowed for in the Regulation.

(c) All forest project types must quantify the net GHG emission reductions and GHG removal enhancements eligible for offset crediting for each reporting period using equation 5.1. Net GHG emission reductions and GHG removal enhancements must be quantified and reported in metric tons of $CO_2e$.

**Equation 5.1. Net GHG Reductions and GHG Removal Enhancements**

$QR_y = [(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,y} - BC_{wp,y}) * 0.80 + SE_y] * (1 - ACD) + N_{y-1}$

*Where,*

| | | |
|---|---|---|
| $QR_y$ | = | Quantified GHG emission reductions and GHG removal enhancements for reporting period y (MT $CO_2e$) |
| $y$ | = | Reporting period |
| $\Delta AC_{onsite}$ | = | The change in actual onsite carbon since the last reporting period (MT$CO_2e$) |
| $\Delta BC_{onsite}$ | = | The change in baseline onsite carbon since the last reporting period (MT $CO_2e$)<br>For improved forest management projects, where baseline onsite carbon stocks are averaged across all reporting periods, the value for $\Delta BC_{onsite}$ will be zero in all reporting periods except the first reporting period of the project. |
| $AC_{wp,y}$ | = | Actual carbon in wood products produced in reporting period y that is projected to remain stored for at least 100 years (i.e., $WP_{total,\ y}$ derived for actual harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| $BC_{wp,y}$ | = | Averaged annual baseline carbon in wood products that would have remained stored for at least 100 years (i.e., $WP_{total,\ y}$ derived for baseline harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| *0.80* | = | Market responses to changes in wood product production. The general assumption in this protocol is that for every ton of reduced harvesting caused by a forest project, the market will compensate with an increase in harvesting of 0.2 tons on other lands. |
| $SE_y$ | = | Secondary effect GHG emissions caused by the project activity in reporting period y (MT $CO_2e$) |
| *ACD* | = | Avoided conversion project discount factor, determined in equation 5.11 (%) |
| $N_{y-1}$ | = | Any negative carryover from the prior reporting period (MT $CO_2e$)<br>Occurs when total quantified GHG emission reductions are negative prior to the issuance of any ARB offset credits for the project. |

With:

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

*Where*,

| | | |
|---|---|---|
| $AC_{onsite,y}$ | = | Actual onsite carbon as inventoried at the end of reporting period y (MT $CO_2e$) |
| $AC_{onsite,y-1}$ | = | Actual onsite carbon as inventoried at the end of reporting period y-1 (MT $CO_2e$)<br>If y is the first reporting period of the offset project, the value for $AC_{onsite,y-1}$ will be zero. |
| $CD_y$ | = | Appropriate confidence deduction for reporting period y, as determined in appendix A (%) |
| $CD_{y-1}$ | = | Appropriate confidence deduction for reporting period y-1, as determined in appendix A (%) |

And:

| | | |
|---|---|---|
| $\Delta\ BC_{onsite}$ | = | $BC_{onsite,y} - BC_{onsite,y-1}$ |
| *Where,* | | |
| $BC_{onsite,y}$ | = | Baseline onsite carbon as estimated at the end of reporting period y (MT $CO_2e$) |
| $BC_{onsite,y-1}$ | = | Baseline onsite carbon as estimated at the end of reporting period y-1 (MT $CO_2e$)<br>If y is the first reporting period of the offset project, the value for $BC_{onsite,y-1}$ will be zero. |

## 5.1. Reforestation Projects

### 5.1.1. Estimating Baseline Onsite Carbon Stocks

The Offset Project Operator or Authorized Project Designee for a reforestation project must estimate baseline onsite carbon stocks according to the following methodology:

(a) Provide a qualitative characterization of the likely vegetative conditions and activities that would have occurred without the project. The qualitative characterization must:

(1) Take into consideration any laws, statutes, regulations, or other legal mandates that would require reforestation on the project area;

(2) Include an assessment of the commercial value of trees within the project area over the next 30 years; and

(3) Be used as the basis for modeling baseline carbon stocks per subchapter 5.1.1(c).

(b) Inventory the carbon stocks in each of the forest project's required carbon pools (identified in table 4.1), following the requirements in appendix A.

(1) For carbon pools that will be affected by site preparation, the inventory must be conducted prior to any site preparation activities. For those carbon pools that are affected by site preparation, provide an estimate of initial carbon stocks by:

(A) Measuring carbon stocks using 20 sample plots located in the portion of the project area containing the greatest amount of biomass in the pool that will be affected;

(B) Stratifying (classifying) the project area into similar densities and measuring stocks within the affected carbon pools using 20 sample plots per density class; or

(C) Measuring the affected carbon stocks based on a grid system across the project area.

(2) For carbon stocks not affected by site preparation, the inventory may be deferred until a reforestation project's submission of the Offset Project Data Report that will undergo the second site-visit verification. If deferred, an estimated inventory of all required carbon stocks at the time of the forest project's offset project commencement date must be prepared for the Offset Project Data Report that will undergo the second site-visit verification by:

(A) Assuming standing dead tree carbon stocks at the offset project commencement date were equal to the standing dead tree carbon stocks measured and verified at the second verification; and

(B) Using an approved growth model or a stand table projection methodology, as described in appendix B, to derive an estimate of standing live tree carbon stocks in pre-existing trees (i.e., those not planted as part of the forest project) at the offset project commencement date. The approved growth model or stand table projection used for the estimate must produce a result within 5 percent of current inventory data for pre-existing trees.

(c) Model the carbon stock change in each of the forest project's required onsite carbon pools (identified in table 4.1) associated with pre-existing trees in the project area (i.e., those not planted as part of the forest project) for 100 years following the forest project's commencement date. The model must:

(1) Follow the requirements and methods in appendix B; and

(2) Incorporate all conditions and constraints specified in the qualitative characterization.

(d) The baseline for a forest project under this version of the protocol is valid for the duration of the project life following a successful initial verification where the offset project receives a positive verification statement.

(1) If a subsequent verification(s) detects correctable errors of greater than 5.00 percent to the baseline or to quantified GHG reductions or GHG removal enhancements, the baseline must be adjusted prior to a verification statement being issued. The corrected baseline would then supersede the

originally verified baseline for the purpose of determining GHG emission reductions and GHG removal enhancements going forward.

(A) Previously issued ARB offset credits will be subject to the invalidation provisions in section 95985 of the Regulation.

(B) In no case will additional ARB offset credit be issued.

(2) If a forest project seeks renewal of its crediting period, the Offset Project Operator or Authorized Project Designee must conform to the most recent version of the Compliance Offset Protocol. Any changes in the baseline that result from the use of the most recent version of the Compliance Offset Protocol that affect GHG emission reductions or removal enhancements from the previous crediting period are not subject to invalidation or additional crediting.

### 5.1.2. Estimating Baseline Carbon in Harvested Wood Products

If harvesting of the pre-existing trees would be expected to occur in the baseline, the Offset Project Operator or Authorized Project Designee for a reforestation project must:

(a) In conjunction with modeling baseline onsite carbon stocks described in subchapter 5.1.1:

(1) Forecast the harvesting of pre-existing trees from within the project area that would have occurred in the baseline, following the requirements of appendix B;

(2) Derive the standing live tree carbon stocks and standing dead tree carbon stocks from the growth and yield model which would have been harvested in each reporting period of the 100-year baseline for the purpose of producing wood products; trees of noncommercial sizes and species are excluded; and

(3) Calculate the average annual amount of carbon that would have been harvested in the baseline ($BC_{hv,n}$ in equations C.8 and C.17).

(b) On an annual basis, determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that would have been harvested during the reporting period for the purpose of producing wood products and

would have remained stored in wood products over 100 years, following the requirements and methods in appendix C; trees of noncommercial sizes and species are excluded.

### 5.1.3. Determining Actual Onsite Carbon Stocks

For each reporting period after the completion of an estimated inventory of all required carbon stocks, the Offset Project Operator or Authorized Project Designee for a reforestation project must determine the forest project's actual onsite carbon stocks by updating the project area's forest carbon inventory according to the following methodology:

(a) Incorporate any new forest inventory data obtained during the reporting period into the inventory estimate. Any plots sampled during the reporting period must be incorporated into the inventory estimate;

(b) Use an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the end of the current reporting period, per the requirements of appendix B;

(c) Update the forest inventory estimate for harvests and/or disturbances that have occurred during the reporting period; and

(d) Apply an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the requirements and methods in appendix A.

### 5.1.4. Determining Actual Carbon in Harvested Wood Products

For each reporting period after the completion of an estimated inventory of all required carbon stocks, the Offset Project Operator or Authorized Project Designee for a reforestation project must determine the forest project's actual carbon in harvested wood products according to the following methodology:

(a) Based on harvest volumes determined in subchapter 5.1.3 and using the same volume and biomass equations used to calculate biomass in live trees and estimate baseline onsite carbon stocks, determine the standing live tree carbon stocks and standing dead tree carbon stocks harvested from within the project area during the reporting period for the purpose of producing wood products; trees of noncommercial sizes and species are excluded ($AC_{hv,n}$ in equations C.8 and C.17).

(b) Determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that is harvested during the reporting period for the purpose of producing wood products and will remain stored in wood products over 100 years, following the requirements and methods in appendix C; trees of noncommercial sizes and species are excluded.

### 5.1.5. Calculating Secondary Effects

For each reporting period after the completion of an estimated inventory of all required carbon stocks, the Offset Project Operator or Authorized Project Designee for a reforestation project must quantify the secondary effects associated with the project.

(a) Secondary effects will almost always be negative (i.e., they will reflect an increase in GHG emissions caused by the offset project). For reforestation projects, significant secondary effects can arise from:
   (1) Mobile combustion emissions associated with machinery used in site preparation; and
   (2) The shifting of cropland or grazing activities to forestland outside the project area (which may be both a market and/or physical response to the project activity).

(b) If the addition of negative secondary effect emissions results in a negative amount for total net quantified GHG emission reductions and GHG removal enhancements in the first reporting period ($QR_1$), the negative amount must be carried over into future reporting periods ($N_{y-1}$ in equation 5.1) until sufficient GHG emission reductions and GHG removal enhancements are accrued to achieve a positive balance. Negative GHG emission reductions and GHG removal enhancements due to site preparation emissions are *not* considered a reversal.

(c) Emissions due to mobile combustion from site preparation must be quantified using equation 5.2 and the appropriate standard emission factor from table 5.1 corresponding to the level of brush cover on the project area.

**Equation 5.2. Combustion Emissions Associated with Site Preparation**

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

*Where,*

| | | |
|---|---|---|
| $MC_y$ | = | Secondary effect emissions due to mobile combustion from site preparation in reporting period y (MT $CO_2e$) |
| $EF_{mc}$ | = | Mobile combustion emission factor from table 5.1 (MT $CO_2e$/acre) |
| $y$ | = | Reporting period |
| $PA$ | = | The size of the project area (acres) |

**Table 5.1. Mobile Combustion Emissions for Reforestation Projects**

| SITE PREP - REFORESTATION PROJECTS<br>Emissions Associated with Mobile Combustion | | |
|---|---|---|
| Average Metric Tons $CO_2e$ per Acre | | |
| Light | Medium | Heavy |
| 0-25% Brush Cover | >25-50% Dense Brush Cover | >50% Brush Cover, Stump Removal |
| 0.090 | 0.202 | 0.429 |

(d) Emissions from shifting cropland and grazing activities must be quantified using equation 5.3 and the appropriate leakage risk percentage for the project by following the decision tree in figure 5.1.

(e) The leakage risk percentage is determined once, at offset project commencement, and remains constant for the duration of the project life.

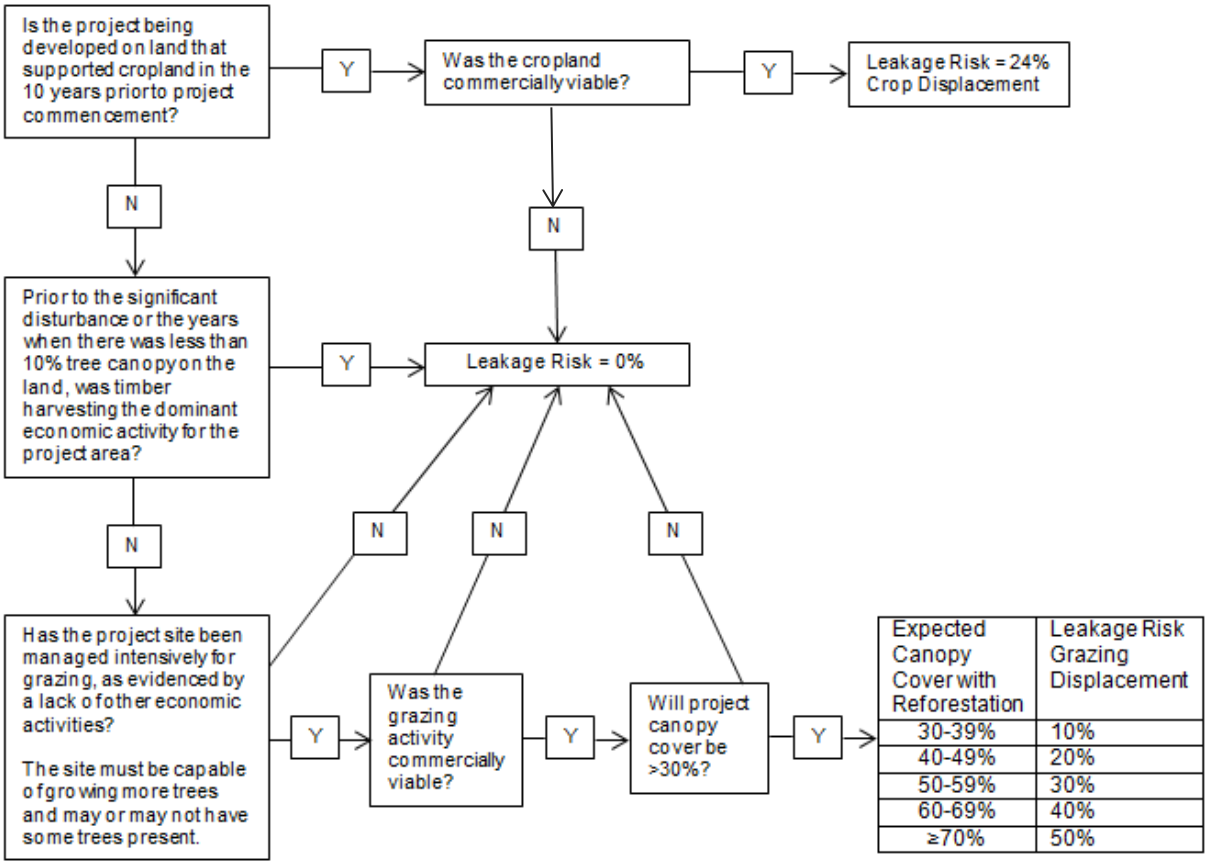
**Equation 5.3. Emissions from Shifting Cropland and Grazing Activities**

$AS_y = (-1) \times L \times (\Delta AC_{onsite} - \Delta BC_{onsite})$

*Where,*

| | | |
|---|---|---|
| $AS_y$ | = | Secondary effect emissions due to shifting of cropland or grazing activities in reporting period y (MT $CO_2e$) |
| $L$ | = | Leakage risk percentage, as determined from figure 5.1 (%) |
| $y$ | = | Reporting period |
| $\Delta AC_{onsite}$ | = | Annual difference in actual onsite carbon as defined in equation 5.1 (MT $CO_2e$) |
| $\Delta BC_{onsite}$ | = | Annual difference in baseline onsite carbon as defined in equation 5.1 (MT $CO_2e$) |

**Figure 5.1. Activity Shifting Leakage Risk Assessment for Reforestation Projects**




(f) Secondary effects must be quantified using equation 5.4.

**Equation 5.4. Total Secondary Effect Emissions**

$SE_y = MIN[(AS_y + MC_y), 0]$

*Where,*

| | | |
|---|---|---|
| $SE_y$ | = | Secondary effect GHG emissions caused by the project activity in reporting period y (MT $CO_2e$) |
| $y$ | = | Reporting period |
| $MIN$ | = | The lowest value in the set of values being evaluated. |
| $AS_y$ | = | Secondary effect emissions due to shifting of cropland or grazing activities in reporting period y (MT $CO_2e$) |
| $MC_y$ | = | Secondary effect emissions due to mobile combustion from site preparation in reporting period y (MT $CO_2e$) |

## 5.2. Improved Forest Management Projects

(a) Improved forest management projects that take place on private land – or on land that is transferred to public ownership at the time the project is initiated –

must estimate baseline onsite carbon stocks following the requirements and procedures in subchapter 5.2.1.

(b) Improved forest management projects that take place on land that was publicly owned prior to the offset project commencement date must estimate baseline onsite carbon stocks following the requirements and procedures in subchapter 5.2.2.

(c) Requirements for determining baseline carbon in harvested wood products, determining actual onsite carbon stocks, determining actual carbon in harvested wood products, and quantifying secondary effects are the same for all improved forest management projects.

### 5.2.1. Estimating Baseline Onsite Carbon Stocks – Private Land

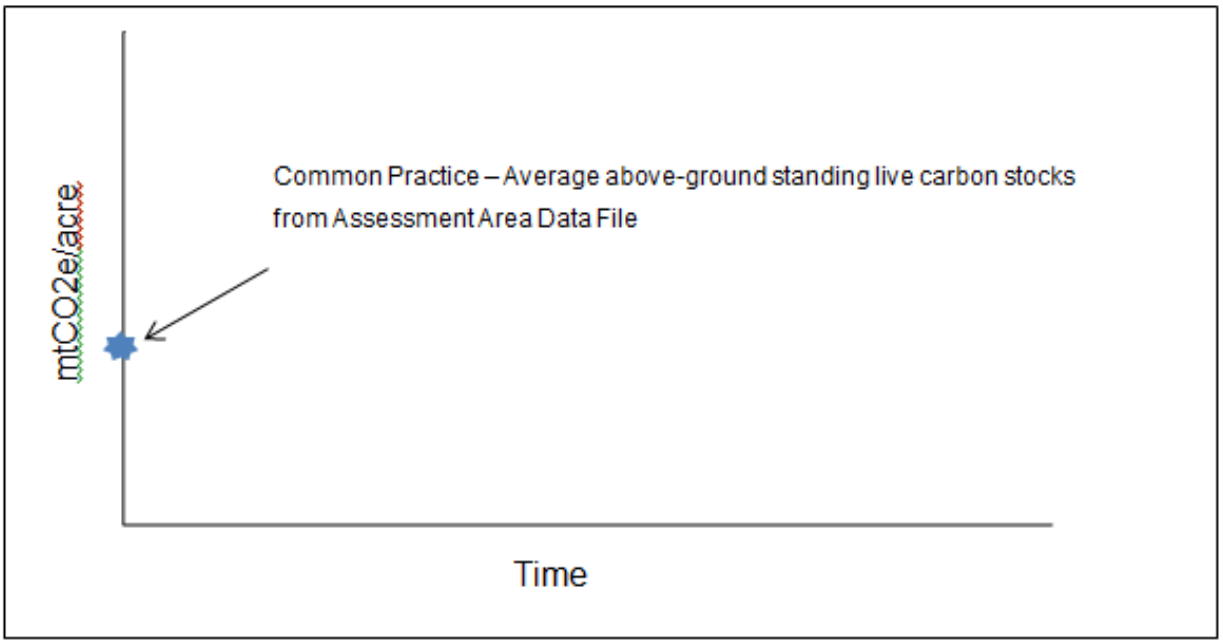
The Offset Project Operator or Authorized Project Designee for an improved forest management project on private land must estimate baseline onsite carbon stocks according to the following methodology:

(a) Conduct an inventory of the onsite carbon stocks in each of the forest project's required onsite carbon pools (identified in table 4.2) following the requirements in appendix A. Develop distinct inventories for:
   (1) Initial above-ground standing live tree carbon stocks;
   (2) Initial below-ground standing live tree carbon stocks;
   (3) Initial standing dead tree carbon stocks (above-ground and below-ground standing dead tree carbon may be combined); and
   (4) Soil carbon stocks, if soil is an included carbon pool per table 4.2.

(b) Calculate the initial above-ground standing live tree carbon stocks per acre within the project area expressed in MT $CO_2e$ (ICS) by:
   (1) Identifying the total metric tons of $CO_2e$ contained in the initial above-ground standing live tree carbon stocks within the project area; and
   (2) Dividing this amount by the number of acres in the project area.

(c) Following the requirements of appendix F, identify the common practice (CP) value for the project area from the Assessment Area Data File associated with this protocol version available in the Forest Offset Protocol Resources section of ARB's website.

**Figure 5.2. Common Practice as a Reference Point for Baseline Estimation**




(d) Determine if the ICS is above or below the CP value and calculate the minimum baseline level for above-ground standing live tree carbon stocks (MBL) accordingly.

(1) If ICS is above CP, determine MBL using equation 5.5:

**Equation 5.5. Determining the Minimum Baseline Level Where Initial Carbon Stocks Are Above Common Practice**

$$MBL = MAX(CP, MIN(ICS, CP + ICS - WCS))$$

*Where,*

| | | |
|---|---|---|
| *MAX* | = | The highest value in the set of values being evaluated |
| *MIN* | = | The lowest value in the set of values being evaluated |
| *MBL* | = | Minimum baseline level for above-ground standing live tree carbon stocks (MT $CO_2e$/acre) |
| *CP* | = | Common Practice (MT $CO_2e$/acre) |
| *ICS* | = | Initial above-ground standing live tree carbon stocks per acre within the project area (MT $CO_2e$/acre) |
| *WCS* | = | The weighted average above-ground standing live tree carbon stocks per acre within the LMU containing the project area (MT $CO_2e$/acre) |

(2) If ICS is below or equal to CP, determine MBL using equation 5.6:

**Equation 5.6. Determining the Minimum Baseline Level Where Initial Carbon Stocks Are Below or Equal to Common Practice**

*MBL = MAX (MAX (HSR, ICS), MIN (CP, WCS))*

*Where,*

| | | |
|---|---|---|
| *MAX* | = | The highest value in the set of values being evaluated |
| *MIN* | = | The lowest value in the set of values being evaluated |
| *MBL* | = | Minimum baseline level for above-ground standing live tree carbon stocks (MT $CO_2e$/acre) |
| *HSR* | = | The "high stocking reference" for the project area (MT $CO_2e$/acre) |
| *CP* | = | Common practice (MT $CO_2e$/acre) |
| *ICS* | = | Initial above-ground standing live tree carbon stocks per acre within the project area (MT $CO_2e$/acre) |
| *WCS* | = | The weighted average above-ground standing live tree carbon stocks per acre for all forest owner(s) (and affiliate) landholdings within the same logical management unit as the project area (MT $CO_2e$/acre) |

(3) Determine the weighted average above-ground standing live tree carbon stocks per acre (WCS) for all forest owner(s) and affiliate(s) landholdings within the same logical management unit (LMU) as the project area. For the purposes of defining the LMU, an affiliate means any person or entity that, directly or indirectly through one or more intermediaries, controls, is controlled by, or is under common control by the forest owner(s), including any general or limited partnership in which the forest owner(s) is a partner and any limited liability company in which the forest owner(s) is a member. For the purposes of this definition, "control" means the possession, direct or indirect, of the power to direct or cause the direction of the management and polices of a person, whether through the ownership of voting securities, by contract or otherwise. For the purposes of this definition, "person" means an individual or a general partnership, limited liability partnership, joint venture, trust, business trust, cooperative or association or any other legally-recognized entity. To determine the WCS, the Offset Project Operator or Authorized Project Designee must:

1. Identify the LMU according to the definition in subchapter 1.2;

2. To calculate WCS, estimate the above-ground standing live tree carbon stocks per acre for the entire LMU containing the project area, including the project area itself;
3. If sufficient inventory data for LMU lands exist to quantify above-ground standing live tree carbon stocks for the entire LMU, then equation 5.7 must be used to calculate WCS; and
4. If sufficient inventory data is not available for the LMU, a stratified vegetation-type analysis must be used to calculate WCS. To conduct this analysis, all landholdings within the LMU, including the project area, must be divided into vegetation types and size class/canopy cover categories as delimited in table 5.2 with a resolution for classification no greater than 40 acres. Each vegetation class has a "carbon rating" provided in table 5.2. WCS must be calculated using the ratio of average carbon stocking on LMU lands relative to carbon stocking on project area lands (referred to as the "stratified carbon weighting factor" or SWF) using equations 5.7, 5.8, and 5.9; and

**Equation 5.7. Formula for WCS Using Inventory Data**

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| \leq 0.2, then\ WCS = ICS$$

$$If \left|\left(1-\frac{ECS}{ICS}\right)\right| > 0.2, then\ WCS = \frac{ICS \cdot PA + ECS \cdot EA}{PA + EA}$$

*Where,*

| | | |
|---|---|---|
| *WCS* | = | The weighted average above-ground standing live tree carbon stocks per acre within the LMU containing the project area (MT $CO_2e$/acre) |
| *ICS* | = | Initial above-ground standing live tree carbon stocks per acre within the project area (MT $CO_2e$/acre) |
| *ECS* | = | Above-ground standing live tree carbon stocks per acre within the LMU but excluding the project area, as determined from existing inventory data (MT $CO_2e$/acre) |
| *PA* | = | Size of the project area (acres) |
| *EA* | = | Size of the LMU, excluding the Project Area (acres) |

**Equation 5.8. Formula for WCS Using Stratified Vegetation-Type Analysis**

$$If\ |(1-SWF)| \leq 0.2, then\ WCS = ICS$$

$$If\ |(1 - SWF)| > 0.2, then\ WCS = \frac{(ICS \cdot PA) + (SWF \cdot ICS \cdot EA)}{PA + EA}$$

*Where,*

*WCS* = The weighted average above-ground standing live tree carbon stocks per acre within the LMU containing the project area (MT $CO_2e$/acre)

*ICS* = Initial above-ground standing live tree carbon stocks per acre within the project area (MT $CO_2e$/acre)

*SWF* = The stratified carbon weighting factor for the LMU (from equation 5.9 below)

*PA* = Size of the project area (acres)

*EA* = Size of the LMU, excluding the project area (acres)

**Equation 5.9. Formula for LMU Stratified Carbon Weighting Factor (SWF)**

$$SWF = \frac{\sum_i (EA_i \cdot CR_i)}{\sum_i EA_i} \div \frac{\sum_i (PA_i \cdot CR_i)}{\sum_i PA_i}$$

*Where,*

*SWF* = The stratified carbon weighting factor for the LMU

$PA_i$ = Acres of the project area in forest vegetation type *i* (from table 5.2) (acres)

$EA_i$ = Acres of the LMU, excluding the project area, in forest vegetation type *i* (from table 5.2) (acres)

$CR_i$ = Carbon rating for forest vegetation type *i* (from table 5.2) (MT $CO_2e$)

**Table 5.2. Vegetation Classes for Stratification**

| Forest Vegetation Description | Average Diameter (Breast Height) | Average Canopy Cover | Carbon Rating |
|---|---|---|---|
| Brush | 0" | NA | 0 |
| Regeneration | 3" | NA | 0.5 |
| Pole-sized trees | 6" - 12" | < 33% | 2 |
| Pole-sized trees | 6" - 12" | 33% - 66% | 4 |
| Pole-sized trees | 6" - 12" | >66% | 6 |
| Small Sawlogs | 12" - 20" | < 33% | 4 |
| Small Sawlogs | 12" - 20" | 33% - 66% | 8 |
| Small Sawlogs | 12" - 20" | >66% | 12 |
| Large Sawlogs | 20" - 36" | < 33% | 8 |
| Large Sawlogs | 20" - 36" | 33% - 66% | 16 |
| Large Sawlogs | 20" - 36" | >66% | 24 |
| Very Large Trees | >36" | < 33% | 16 |
| Very Large Trees | >36" | 33% - 66% | 32 |
| Very Large Trees | >36" | >66% | 48 |

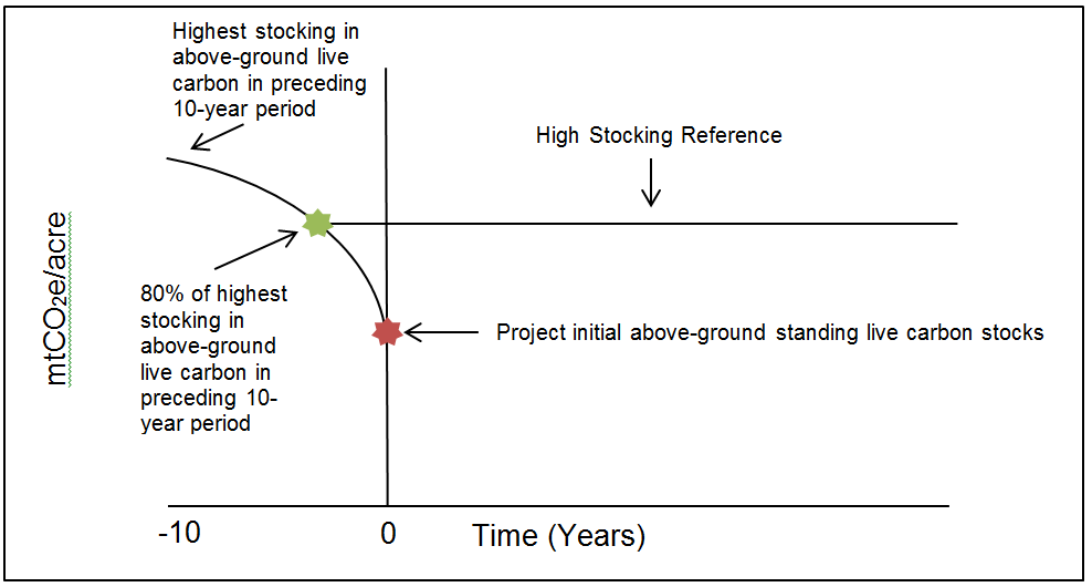
(4) Determine the high stocking reference (HSR) for the project area. The high stocking reference is defined as 80 percent of the highest value for above-

ground standing live tree carbon stocks per acre within the project area during the preceding 10-year period;

(A) To determine the high stocking reference, the Offset Project Operator or Authorized Project Designee must document changes in the project area's above-ground standing live tree carbon stocks over the preceding 10 years; and

(B) Figure 5.3 presents a graphical portrayal of a high stocking reference determination;

**Figure 5.3. Determining a Project Area's High Stocking Reference**




(e) Model the onsite carbon stocks, keeping the carbon pools listed in subchapter 5.2.1(a) distinct, through a series of growth and harvesting scenarios over 100 years beginning with the initial carbon stocks at the time of offset project commencement. Modeling must follow the requirements and methods in appendix B, and reflect a financially feasible scenario that includes all legal constraints.

(1) All legal constraints that could affect baseline growth and harvesting scenarios must be incorporated into the modeled baseline. Legal constraints include all laws, regulations, and legally-binding commitments applicable to the project area at the time of offset project commencement that could affect standing live tree carbon stocks. Legal constraints include:

(A) Federal, state, or local government regulations that are required and might reasonably be anticipated to influence carbon stocking over time, including, but not limited to:
    1. Zones with harvest restrictions (e.g., buffers, streamside protection zones, wildlife protection zones);
    2. Harvest adjacency restrictions; and
    3. Minimum stocking standards;

(B) Forest practice rules, or applicable Best Management Practices established by federal, state, or local government that relate to forest management;

(C) Other legally binding requirements affecting carbon stocks, including, but not limited to, covenants, conditions and restrictions, and other title restrictions in place prior to or at the time of project initiation, including pre-existing conservation easements, Habitat Conservation Plans, Safe Harbor Agreements, and deed restrictions, excepting an encumbrance that was put in place and/or recorded less than or equal to one year prior to the offset project commencement date, as defined in subchapter 3.6;
    1. Voluntary agreements that can be rescinded, such as rental contracts and forest certifications, are not legal constraints;
    2. Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs) that are in place more than one year prior to the offset project commencement date must be modeled as legal constraints; and
    3. HCPs and SHAs that are approved after the date one year prior to the offset project commencement date are not considered legal constraints for the purpose of baseline modeling and do not need to be incorporated into baseline modeling; and

(D) For forest projects located in California, the baseline must be modeled to reflect all silvicultural treatments associated with any submitted, active, or approved timber harvest plans (THPs) at the time of offset

project commencement that would affect harvesting and management within the project area during the project life.

1. All legally enforceable silvicultural and operational provisions of a THP – including those operational provisions designed to meet California Forest Practice Rules requirements for achieving Maximum Sustained Production of High Quality Wood Products [14 CCR 913.11 (933.11, 953.11)] – are considered legal constraints and must be reflected in baseline modeling for as long as the THP will remain active;
2. For portions of the project area not subject to THPs (or over time periods for which THPs will not be active), baseline carbon stocks must be modeled by taking into account any applicable requirements of the California Forest Practice Rules and all other applicable laws, regulations, and legally binding commitments that could affect onsite carbon stocks; and
3. If the California Department of Forestry and Fire Protection (Cal FIRE) has assisted in identifying minimum carbon stocking levels that would be effectively required under California Forest Practice Rules, they must be modeled into the baseline.

(2) All financial constraints that could affect baseline growth and harvesting scenarios must be incorporated into the modeled baseline. It must be demonstrated that the growth and harvesting regime assumed for the baseline is financially feasible through one of the following means:

(A) Conducting a financial analysis of the anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints. Cost and revenue variables in the financial analysis may be based on regional norms or on documented costs and returns for the project area or other properties in the forest project's assessment area; or

(B) Providing evidence that activities similar to the proposed baseline growth and harvesting regime have taken place within the past 15 years on at least three other properties within the forest project's

assessment area. At least one comparable site must be on land not owned by the forest owner(s) and/or its affiliates, and no more than one comparable site may be within the project area. Comparable sites on land owned by the forest owner(s) and/or its affiliates must not have had harvest activities within two years before the offset project commencement date. The evidence must demonstrate that harvesting activities have taken place on at least three other comparable sites with:

1. Slopes, as measured by average percent slope, that are not more than 10.0 percent less than the average slopes in the project area or that use the same methods (tractor, cable, helicopter, etc.) for logging;
2. Functionally equivalent zoning class(es) to the project area (if applicable); and
3. Comparable species composition to the project area which may be evidenced by the following:
   a. Comparable property species composition is within 20 percent of project species composition based on trees per acre;
   b. Identical codominant species; or
   c. Identical Forest Type as defined by the USDA Forest Inventory and Analysis Database Description and User Guide for Phase 2 (V6.0.1), Appendix D.

(f) For each carbon pool listed in subchapter 5.2.1(a), average the periodic modeled outputs to achieve a 100-year average annual value ($CO_2e$/acre) for each modeled carbon pool.

(1) The averaged model results for above-ground standing live tree carbon stocks ($CO_2e$/acre) must not fall below the MBL. If it does fall below the MBL, the silvicultural activities must be modified so that the averaged model results for above-ground standing live tree carbon stocks are equal to or above the MBL.

(2) Figure 5.4 shows a graphical example of the ICS, CP and the 100-year modeled above-ground standing live tree carbon stocks when ICS is above

CP. Figure 5.5 shows the same graphical example with the addition of the MBL and averaged 100-year modeled above-ground standing live tree carbon stocks.

**Figure 5.4. Graphical Example of Initial Above-Ground Standing Live Tree Carbon Stocks (ICS), Common Practice (CP), and Modeled Above-Ground Standing Live Tree Carbon Stocks Where ICS > CP**

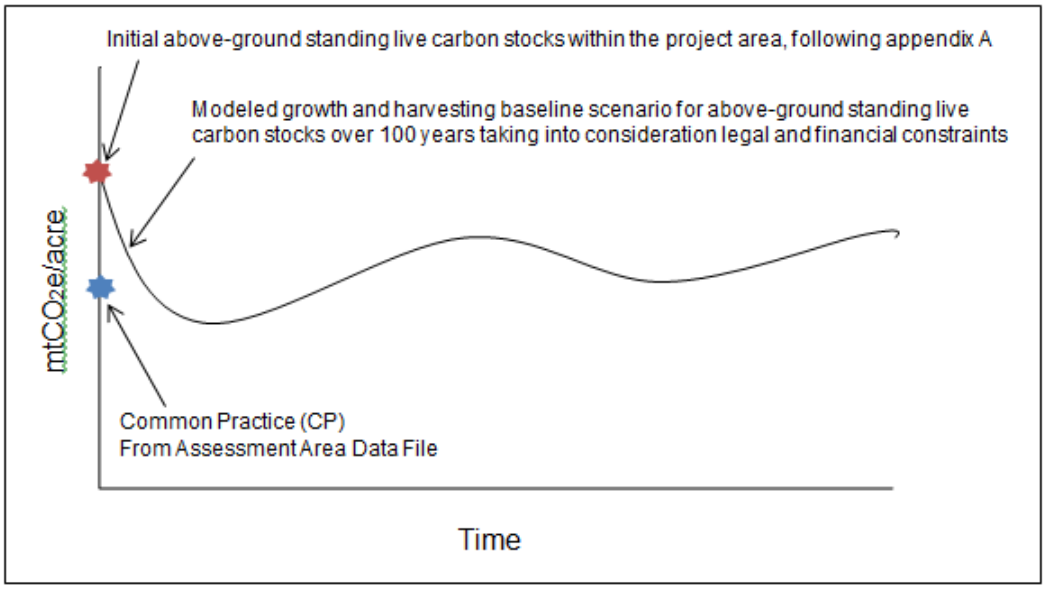
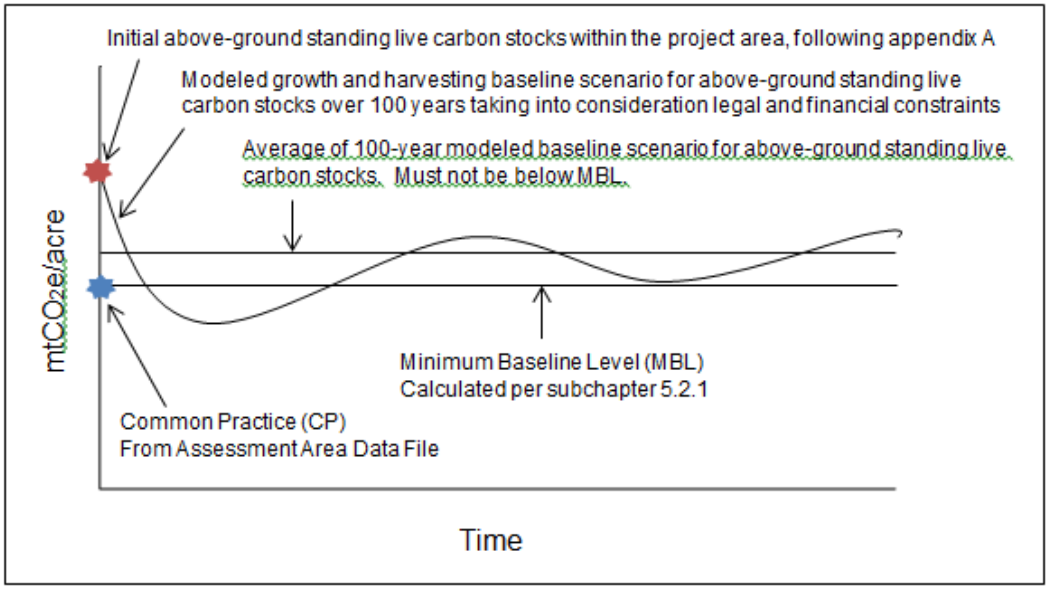


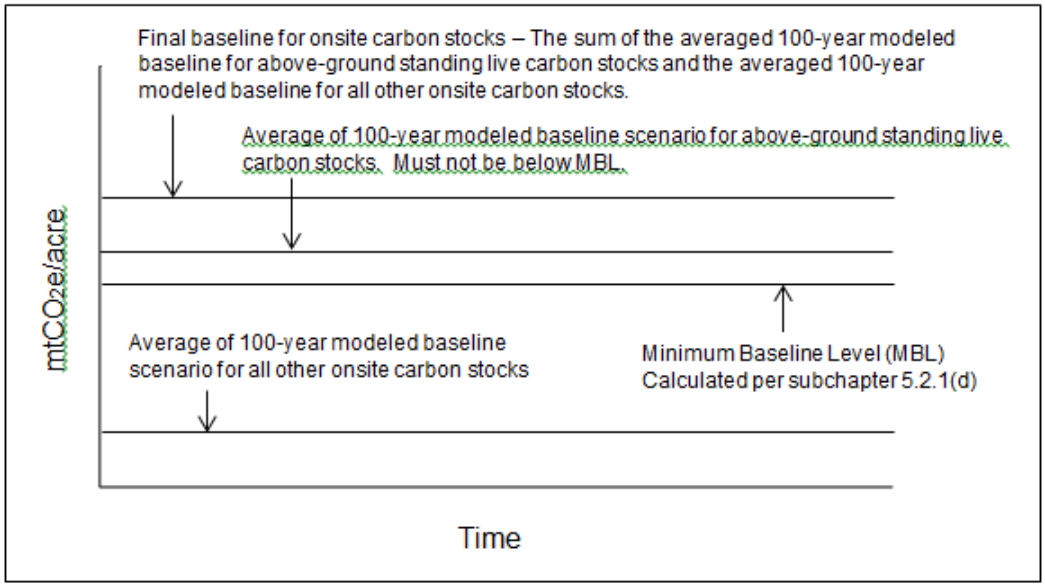

**Figure 5.5. Graphical Example with Addition of the Minimum Baseline Level (MBL) and Averaged 100-year Modeled Above-Ground Standing Live Tree Carbon Stocks**




(g) Sum the above-ground standing live tree carbon stocks baseline and the baseline for all other onsite carbon stocks (below-ground standing live tree

carbon, above-ground standing dead tree carbon, below-ground standing dead tree carbon, and soil if soil is an included carbon pool per table 4.2) to produce a final baseline for all onsite carbon pools (see figure 5.6).

**Figure 5.6. Final Baseline Incorporating All Required Onsite Carbon Pools**




(h) The baseline model for a forest project under this version of the protocol is valid for the duration of the project life following a successful initial verification where the offset project receives a positive verification statement with the following exceptions:

(1) If a subsequent verification(s) detects correctable errors of greater than 5.00 percent to the baseline or to quantified GHG reductions or GHG removal enhancements, the baseline must be adjusted prior to a verification statement being issued. The corrected baseline would then supersede the originally verified baseline for the purpose of determining GHG emission reductions and GHG removal enhancements going forward.

(A) Previously issued ARB offset credits will be subject to the invalidation provisions in section 95985 of the Regulation.

(B) In no case will additional ARB offset credit be issued.

(2) If a forest project seeks renewal of its crediting period, the Offset Project Operator or Authorized Project Designee must conform to the most recent version of the Compliance Offset Protocol. Any changes in the baseline that

result from the use of the most recent version of the Compliance Offset Protocol that affect GHG emission reductions or removal enhancements from the previous crediting period are not subject to invalidation or additional crediting.

### 5.2.2. Estimating Baseline Onsite Carbon Stocks – Public Land

The Offset Project Operator or Authorized Project Designee for an improved forest management project on lands owned or controlled by public agencies must estimate baseline onsite carbon stocks according to the following methodology:

(a) Inventory the carbon stocks in each of the forest project's required carbon pools (identified in table 4.2), following the requirements in appendix A;

(b) Project future changes to carbon stocks within the project area by:

  (1) Extrapolating from historical trends per the following:

    (A) For project areas that have a ten-year history of declining carbon stocks, the baseline must be defined by the average of the carbon stocks over the past ten years and considered static for the project life (i.e., the same level of carbon stocks is assumed in every year); or

    (B) For project areas that demonstrate an increasing inventory of carbon stocks over the past ten years, the growth trajectory of the baseline must continue until the forest (under the baseline stocks) achieves a stand composition consistent with comparable forested areas that have been relatively free of harvest over the past 60 years;

      1. If comparable forested areas within the project's assessment area are unavailable the project area inventory must be modeled using one of the approved growth models (see appendix B) to represent a standardized forested area relatively free of harvest for 60 years; and

  (2) Modeling current public policy in the baseline onsite carbon stocks over 100-years following the requirements and methods in appendix B incorporating constraints imposed by all applicable statutes, regulations, policies, plans and activity-based funding;

(c) The method that results in the highest estimated carbon stock levels must be used to determine the baseline;

(d) Average the results over the 100-year timeframe so that the baseline is expressed as a single (average) annual value; and

(e) The baseline for a forest project under this version of the protocol is valid for the duration of the project life following a successful initial verification where the offset project receives a positive verification statement.

(1) If a subsequent verification(s) detects correctable errors of greater than 5.00 percent to the baseline or to quantified GHG reductions or GHG removal enhancements, the baseline must be adjusted prior to a verification statement being issued. The corrected baseline would then supersede the originally verified baseline for the purpose of determining GHG emission reductions and GHG removal enhancements going forward.

(A) Previously issued ARB offset credits will be subject to the invalidation provisions in section 95985 of the Regulation.

(B) In no case will additional ARB offset credit be issued.

(2) If a forest project seeks renewal of its crediting period, the Offset Project Operator or Authorized Project Designee must conform to the most recent version of the Compliance Offset Protocol. Any changes in the baseline that result from the use of the most recent version of the Compliance Offset Protocol that affect GHG emission reductions or removal enhancements from the previous crediting period are not subject to invalidation or additional crediting.

### 5.2.3. Estimating Baseline Carbon in Harvested Wood Products

The Offset Project Operator or Authorized Project Designee for an improved forest management project must:

(a) In conjunction with modeling baseline onsite carbon stocks described in subchapter 5.2.1 for projects on private land or subchapter 5.2.2 for projects on public land:

(1) Forecast the harvesting of trees from within the project area that would have occurred in the baseline, following the requirements of appendix B;

(2) Derive the standing live tree carbon stocks and standing dead tree carbon stocks from the growth and harvesting model, which would have been harvested in each reporting period of the 100 year baseline for the purpose of producing wood products; trees of noncommercial sizes and species are excluded; and

(3) Calculate the average annual amount of carbon that would have been harvested in the baseline ($BC_{hv,n}$ for use in equations C.8 and C.17).

(b) On an annual basis, determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that would have been harvested during the reporting period for the purpose of producing wood products and would have remained stored in wood products over 100 years, following the requirements and methods in appendix C; trees of noncommercial sizes and species are excluded.

### 5.2.4. Determining Actual Onsite Carbon Stocks

Each reporting period the Offset Project Operator or Authorized Project Designee for an improved forest management project must determine the forest project's actual onsite carbon stocks by updating the project area's forest carbon inventory according to the following methodology:

(a) Incorporate any new forest inventory data obtained during the reporting period into the inventory estimate. Any plots sampled during the previous reporting period must be incorporated into the inventory estimate;

(b) Use an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the end of the reporting period, per the requirements of appendix B;

(c) Update the forest inventory estimate for harvests and/or disturbances that have occurred during the reporting period; and

(d) Apply an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the requirements and methods in appendix A.

### 5.2.5. Determining Actual Carbon in Harvested Wood Products

Each reporting period the Offset Project Operator or Authorized Project Designee for an improved forest management project must determine the forest project's actual carbon in harvested wood products according to the following methodology:

(a) Based on harvest volumes determined in subchapter 5.2.4 and using the same volume and biomass equations used to calculate biomass in live trees and estimate baseline onsite carbon stocks, determine the actual standing live tree carbon stocks and standing dead tree carbon stocks harvested from within the project area during the reporting period for the purpose of producing wood products; trees of noncommercial sizes and species are excluded ($AC_{hv,n}$ for use in equations C.8 and C.17).

(b) Determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that is harvested during the reporting period for the purpose of producing wood products and will remain stored in wood products over 100 years, following the requirements and methods in appendix C; noncommercial sizes and species are excluded.

### 5.2.6. Calculating Secondary Effects

Each reporting period the Offset Project Operator or Authorized Project Designee for an improved forest management project must quantify the secondary effects associated with the project.

(a) Secondary effects will almost always be negative (i.e., they will reflect an increase in GHG emissions caused by the offset project). For improved forest management projects, significant secondary effects can occur if a project reduces harvesting in the project area, resulting in an increase in harvesting on other properties.

(b) Secondary effects must be quantified using equation 5.10.

**Equation 5.10. Secondary Effects Emissions**

$$If \sum_{n=1}^{y} (AC_{se,n} - BC_{se,n}) \geq 0, then\ SE_y = 0$$

$$If \sum_{n=1}^{y} \left(AC_{se,n} - BC_{se,n}\right) < 0, then\ SE_y = \left(AC_{se,y} - BC_{se,y}\right) \times 0.20$$

*Where,*

$SE_y$ = Estimated annual secondary effects (MT $CO_2e$)

$y$ = The reporting period

$AC_{se,n}$ = Actual amount of carbon in standing live and standing dead trees (whole tree including belowground biomass and bark) harvested by reporting period y

$BC_{se,n}$ = Estimated average baseline amount of carbon in standing live and standing dead trees (whole tree including belowground biomass and bark) that would have been harvested by reporting period y

## 5.3. Avoided Conversion Projects

### 5.3.1. Estimating Baseline Onsite Carbon Stocks

The baseline for avoided conversion projects is a projection of onsite forest carbon stock losses that would have occurred over time due to the conversion of the project area to a non-forest land use. The Offset Project Operator or Authorized Project Designee for an avoided conversion project must estimate baseline onsite carbon stocks according to the following methodology:

(a) Characterize the baseline. The project baseline must be characterized by:

(1) Clearly specifying an alternative highest-value land use for the project area, as identified by an appraisal (required in subchapter 3.4.2); and

(2) Estimating the rate of conversion and removal of onsite carbon stocks, taking into consideration any laws, statutes, regulations, or other legal mandates that affect land use conversion or removal of onsite carbon stocks. The rate of conversion and removal of onsite carbon stocks must be estimated by either:

(A) Referencing planning documentation for the project area (e.g., construction documents or plans) that specifies the timeframe of the conversion and intended removal of forest cover on the project area; or

(B) In the absence of specific documentation, identifying default total conversion impact and annual conversion values from table 5.3.

**Table 5.3. Default Avoided Conversion Values**

| Type of Conversion Identified in Appraisal | Total Conversion Impact<br><br>This is the assumed total effect over time of the conversion activity. (The total conversion impact is amortized over a 10-year period to determine the annual conversion in the next column.) | Annual Conversion<br><br>This is the assumed annual conversion activity. The percentages below are multiplied by the initial onsite carbon stocks for the project on an annual basis for the first 10 years of the project. |
|---|---|---|
| Residential | Estimate using the following formula:<br><br>TC = min(100, (P*3 / PA)*100)<br><br>*Where:*<br>TC = % total conversion (TC cannot exceed 100%)<br>PA = the project area (acres) identified in the appraisal<br>P = the number of unique parcels that would be formed on the project area as identified in the appraisal<br><br>*Each parcel is assumed to deforest 3 acres of forest vegetation. | Estimate using the following formula:<br><br>AC = TC / 10<br><br>*Where:*<br>AC = % annualized conversion<br>TC = % total conversion |
| Mining and agricultural conversion, including pasture or crops | 90% | 9.0% |
| Recreation | 80% | 8.0% |
| Commercial and Industrial buildings | 95% | 9.5% |

(b) Model changes in onsite carbon stocks over 100 years, reflecting the rate of conversion estimated in subchapter 5.3.1(a)(2). The simulation must model changes in onsite carbon stocks for all required carbon pools identified in table 4.3.

(1) The baseline model must apply the identified rate of conversion over 100-years to estimate changes in onsite carbon stocks, beginning with the project area's initial onsite carbon stocks at the time of offset project commencement determined following the requirements in appendix A; and

(2) If the projected conversion rate does not result in a complete removal of onsite forest carbon stocks, the baseline projection must account for any residual forest carbon value as a steady condition for the balance of a 100-year projection.

(c) Discount for the uncertainty of conversion probability.

(1) If quantified GHG emission reductions and GHG removal enhancements are zero or negative for the reporting period, no discount is applied.

(2) If quantified GHG emission reductions and GHG removal enhancements are positive for the reporting period, compare the fair market value of the anticipated alternative land use for the project area (as determined by the appraisal required in subchapter 3.4.2) to the value of the current forested land use. If the fair market value of the anticipated alternative land use for the project area is not more than 80 percent greater than the value of the current forested land use, then a discount must be applied each reporting period to the offset project's quantified GHG emission reductions and GHG removal enhancements. The cost of conversion to alternative land use should not be added to the appraisal value for the purpose of assessing the Discount for Uncertainty of Conversion Probability.

(A) Use equation 5.11 to determine the avoided conversion discount factor.

(B) After the initial verification, the uncertainty discount does not change.

**Equation 5.11. Avoided Conversion Discount Factor**

*Evaluate:* $(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,y} - BC_{wp,y}) * 0.80 + SE_y$

*Where,*

| | | |
|---|---|---|
| $\Delta AC_{onsite}$ | = | The change in actual onsite carbon since the last reporting period (MT $CO_2e$) |
| $\Delta BC_{onsite}$ | = | The change in baseline onsite carbon since the last reporting period (MT $CO_2e$) |
| $AC_{wp,y}$ | = | Actual carbon in wood products produced in reporting period y that is projected to remain stored for at least 100 years (i.e., $WP_{total,\ y}$ derived for actual harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| $BC_{wp,y}$ | = | Averaged annual baseline carbon in wood products that would have remained stored for at least 100 years (i.e., $WP_{total,\ y}$ derived for baseline harvest volumes following the requirements and methods in appendix C) (MT $CO_2e$) |
| *0.80* | = | Market responses to changes in wood product production. The general assumption in this protocol is that for every ton of reduced harvesting caused by a forest project, the market will compensate with an increase in harvesting of 0.2 tons on other lands. |
| $SE_y$ | = | Secondary effect GHG emissions caused by the project activity in reporting period y (MT $CO_2e$) |
| *y* | = | Reporting period |

With:

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

*Where,*

$AC_{onsite,y}$ = Actual onsite carbon as inventoried for reporting period y (MT $CO_2e$)

$AC_{onsite,y-1}$ = Actual onsite carbon as inventoried for reporting period y-1 (MT $CO_2e$)
If y is the first reporting period of the offset project, the value for $AC_{onsite,y-1}$ will be zero.

$CD_y$ = Appropriate confidence deduction for reporting period y, as determined in appendix A (%)

$CD_{y-1}$ = Appropriate confidence deduction for reporting period y-1, as determined in appendix A (%)

And:

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

*Where,*

$BC_{onsite,y}$ = Baseline onsite carbon as estimated for reporting period y (MT $CO_2e$)

$BC_{onsite,y-1}$ = Baseline onsite carbon as estimated for reporting period y-1 (MT $CO_2e$)
If y is the first reporting period of the offset project, the value for $BC_{onsite,y-1}$ will be zero.

If result < 0, then ACD = 0
If result > 0, then evaluate:

*(VA / VP) – 1*

*Where,*

*ACD* = The avoided conversion project discount factor

*VA* = The appraised fair market value of the anticipated alternative land use for the project area

*VP* = The appraised fair market value of the current forested land use for the project area

If result ≤ 0.4, then ACD = 1
If 0.4 < result < 0.8, then ACD = [0.80 – ((VA / VP) – 1)] x 2.5
If result ≥ 0.8, then ACD = 0

(d) The baseline for a forest project under this version of the protocol is valid for the duration of the project life following a successful initial verification where the offset project receives a positive verification statement.

(1) If a subsequent verification(s) detects correctable errors of greater than 5.00 percent to the baseline or to quantified GHG reductions or GHG removal enhancements, the baseline must be adjusted prior to a verification statement being issued. The corrected baseline would then supersede the

originally verified baseline for the purpose of determining GHG emission reductions and GHG removal enhancements going forward.

(A) Previously issued ARB offset credits will be subject to the invalidation provisions in section 95985 of the Regulation.

(B) In no case will additional ARB offset credit be issued.

(2) If a forest project seeks renewal of its crediting period, the Offset Project Operator or Authorized Project Designee must conform to the most recent version of the Compliance Offset Protocol. Any changes in the baseline that result from the use of the most recent version of the Compliance Offset Protocol that affect GHG emission reductions or removal enhancements from the previous crediting period are not subject to invalidation or additional crediting.

### 5.3.2. Estimating Baseline Carbon in Harvested Wood Products

Harvesting is assumed to occur in the baseline over time as the project area is converted to another land use. The Offset Project Operator or Authorized Project Designee for an avoided conversion project must:

(a) In conjunction with modeling baseline onsite carbon stocks described in subchapter 5.3.1:

(1) Forecast the harvesting of trees from within the project area that would have occurred in the baseline, consistent with the rate of reduction in baseline standing live and standing dead carbon stocks and following the requirements of appendix B;

(2) Derive the standing live tree carbon stocks and standing dead tree carbon stocks from the growth and yield model which would have been harvested in each reporting period of the 100-year baseline, for the purpose of producing wood products; trees of noncommercial sizes and species are excluded; and

(3) Calculate the average annual amount of carbon that would have been harvested in the baseline ($BC_{hv,n}$ in equations C.8 and C.16).

(b) On an annual basis, to determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that would have been harvested

during the reporting period for the purpose of producing wood products and would have remained stored in wood products, averaged over 100 years, following the requirements and methods in appendix C; trees of noncommercial sizes and species are excluded.

### 5.3.3. Determining Actual Onsite Carbon Stocks

Each reporting period the Offset Project Operator or Authorized Project Designee for an avoided conversion project must determine the forest project's actual onsite carbon stocks by updating the project area's forest carbon inventory according to the following methodology:

(a) Incorporate any new forest inventory data obtained during the reporting period into the inventory estimate. Any plots sampled during the previous reporting period must be incorporated into the inventory estimate;

(b) Use an approved model to "grow" (project forward) prior-year data from existing forest inventory plots to the end of the reporting period, per the requirements of appendix B;

(c) Update the forest inventory estimate for harvests and/or disturbances that have occurred during the reporting period; and

(d) Apply an appropriate confidence deduction for the inventory based on its statistical uncertainty, following the requirements and methods in appendix A.

### 5.3.4. Determining Actual Carbon in Harvested Wood Products

Each reporting period the Offset Project Operator or Authorized Project Designee for an avoided conversion forest management project must determine the forest project's actual carbon in harvested wood products according to the following methodology:

(a) Based on harvest volumes determined in subchapter 5.3.3 and using the same volume and biomass equations used to estimate carbon in standing live trees and estimate baseline onsite carbon stocks, determine the actual standing live tree carbon stocks and standing dead tree carbon stocks harvested from within the project area during the reporting period for the purpose of producing wood products; trees of noncommercial sizes and species are excluded ($AC_{hv,n}$ for use in equations C.8 and C.17); and

(b) Determine the amount of carbon in standing live and standing dead trees (bole only, excluding bark) that is harvested during the reporting period for the purpose of producing wood products and will remain stored in wood products over 100 years, following the requirements and methods in appendix C; noncommercial sizes and species are excluded.

### 5.3.5. Calculating Secondary Effects

Each reporting period the Offset Project Operator or Authorized Project Designee for an avoided conversion project must quantify the secondary effects associated with the project.

(a) Secondary effects will always be negative (i.e., they will reflect an increase in GHG emissions caused by the offset project) or zero. For avoided conversion projects, significant secondary effects can arise if the type of land use conversion that would have happened on the project area is shifted to other forest land.

(b) Secondary effects must be quantified using equation 5.12.

**Equation 5.12. Secondary Effects Emissions**

$$SE_y = MIN[(-0.036 \times (\Delta AC_{onsite} - \Delta BC_{onsite}), 0]$$

*Where,*

| | | |
|---|---|---|
| $SE_y$ | = | Secondary Effect GHG emissions caused by the project activity in reporting period y (MT $CO_2e$) |
| $y$ | = | Reporting period |
| $MIN$ | = | The lowest value in the set of values being evaluated |
| $-0.036$ | = | Conversion displacement risk value |
| $\Delta AC_{onsite}$ | = | Annual difference in actual onsite carbon as defined in equation 5.1 (MT $CO_2e$) |
| $\Delta BC_{onsite}$ | = | Annual difference in baseline onsite carbon as defined in equation 5.1 (MT $CO_2e$) |

## Chapter 6. Monitoring – Quantification Methodology

The Offset Project Operator or Authorized Project Designee must conduct monitoring activities in accordance with the Regulation and this protocol.

(a) Monitoring is required for a period of 100 years following the final issuance of any ARB offset credits to an offset project.

(b) For forest projects, monitoring activities consist primarily of annually updating a project's forest carbon inventory. This complete inventory must be maintained and updated throughout the project life.

(c) At the time of offset project listing, the Offset Project Operator or Authorized Project Designee for an improved forest management or avoided conversion project must submit a forest carbon inventory methodology for each of the included carbon pools, following the requirements of appendix A, and a modeling plan, following the requirements of appendix B, detailing the specific methods that will be used to update the project's forest carbon inventory on an annual basis. The Offset Project Operator or Authorized Project Designee for a reforestation project may defer submission of these items until the submission of the Offset Project Data Report that will undergo the second site-visit verification.

(d) The forest carbon inventory methodology and modeling plan must adhere to the requirements and methods in appendices A and B, which establish the equations and models for computing biomass and the limits to which computer models can be used in the inventory update process.

(e) Specific methods used to update the forest inventory must follow the inventory methodologies approved at the time the project is initially verified. Modifications to inventory methodologies must achieve an equal or greater accuracy relative to the original sampling design and be approved in advance by a third-party verification body and by ARB, and documented in the change log.

(f) Annual onsite carbon stock estimates are computed from inventory data. Inventory data must be updated annually by:

(1) Incorporating any new forest inventory data obtained during the reporting period;

(2) Modeling growth in sample plots using approved growth models and stand table projection methods (see appendix B regarding growth models and stand table projections); and

(3) Updating the forest inventory data for harvests and/or disturbances that have occurred during the reporting period.

(g) The Offset Project Operator or Authorized Project Designee is required to keep all documentation and information outlined in the Regulation and this protocol. Record retention requirements are set forth in section 95976 of the Regulation.

## Chapter 7. Reporting

In addition to the offset project requirements set forth in sections 95975 and 95976 of the Regulation, forest offset projects must adhere to the project listing and reporting requirements below.

### 7.1. Listing Requirements

(a) Listing information must be submitted by the Offset Project Operator or Authorized Project Designee no later than the date on which the Offset Project Operator or Authorized Project Designee submits the first Offset Project Data Report.

(b) The listing information must be submitted by the Offset Project Operator or Authorized Project Designee again as part of the initial Offset Project Data Report and is subject to verification at the initial and all subsequent offset project verifications.

(c) Reforestation projects as qualified in subchapter 5.1.1(b)(2) can defer the items that are marked with an asterisk until submission of the Offset Project Data Report that will undergo the second site-visit verification.

(d) All listing information that reference carbon stocks must be submitted with the oversight of a Professional Forester.

(e) In order for a U.S. forest compliance offset project to be listed, the Offset Project Operator or Authorized Project Designee must submit the information required by section 95975 of the Regulation in addition to the following information on the basis of activity type:

#### 7.1.1. All Forest Offset Projects

(a) All forest projects must provide:

(1) Offset project name;

(2) Offset project type (reforestation, improved forest management, or avoided conversion);

(3) Contact information, including name, phone number, mailing address, physical address (if different from mailing address) and email address for:
    (A) Offset Project Operator;
    (B) Authorized Project Designee (if applicable);
    (C) The person submitting the information; and
    (D) Any technical consultants;
(4) CITSS ID number for the:
    (A) Offset Project Operator; and
    (B) Authorized Project Designee (if applicable);
(5) Date listing information is completed for submittal;
(6) Indicate whether the Offset Project Operator is the owner in fee for the project area;
    (A) If yes, provide documentation (e.g., deed of trust, title report) showing the Offset Project Operator's ownership interest in the property and its interest in the trees and standing timber on the property;
    (B) If no, explain how the entity identified as the Offset Project Operator has the legal authority to implement the offset project and provide documentation supporting the explanation;
(7) Description of forestland and resource ownership for the real property within the project area;
(8) Name and mailing address of all forest owners including in fee as well as third parties with existing property interests within the project area that may have an effect on the trees and standing timber located in the project area (e.g., mineral rights, timber rights, easements, rights of way, leases, etc.);
(9) Name and mailing address of other parties with a material interest in the real property involved in the forest project;
(10) Physical address of the project site (if available);
(11) Indicate if the offset project occurs on public or private lands, and further specify if the offset project occurs on any of the following categories of land:
    (A) Land that is owned by, or subject to an ownership or possessory interest of a Tribe;

(B) Land that is “Indian lands” of a Tribe, as defined by 25 U.S.C. §81(a)(1); or

(C) Land that is owned by any person, entity, or Tribe, within the external borders of such Indian lands;

(12) If the project is located on one of the above categories of land, a description and copies of documentation demonstrating that the land is owned by (or subject to an ownership or possessory interest of) a tribe or private entities;

(13) If the forest project is located on public land, describe the approval process and public vetting processes necessary to evaluate management and policy decisions concerning the offset project that has or will take place in order to obtain approval of the offset project’s management activities and baseline;

(14) Identify the assessment area(s) in which the project area is located including:

(A) How many acres of project lands fall within each assessment area; and

(B) The total project area acreage;

(15) Descriptions and a georeferenced GIS shapefile of the project area boundary, of adequate resolution to clearly identify the following features:

(A) Governing jurisdictions, and latitude/longitude coordinates;

(B) Public and private roads, distinguished separately (map only);

(C) Towns (map only);

(D) Major watercourses ($4^{th}$ order or greater), water bodies, and watershed description (map only);

(E) Topography (map only);

(F) Townships, ranges, and sections (map only);

(G) Existing land cover and land use (description with optional map);

(H) Forest vegetation types (description with optional map);

(I) Site classes as described in Appendix F (description with optional map);

(J) Land pressures and climate zone/classification (description with optional map); and

(K) Historical land uses, current zoning, and projected land use within project area and surrounding areas (description with optional map);

(16) Offset project commencement date and specification of the action(s) that identify the offset project commencement date. Explain and justify the commencement date;

(17) Initial reporting period start and end dates;

(18) Description of the management activities that will lead to increased carbon stocks in the project area, compared to the baseline;

(19) Description of the forest conditions within the project area, including:

(A) Species (tree) composition;

(B) Age class distribution; and

(C) Management history;

(20) Indicate whether the project will employ a qualified conservation easement. If yes:

(A) Include the date the qualified conservation easement was or will be recorded;

(B) Include the terms that affect forest management within the easement;

(C) Indicate whether the project is located in a state that requires third-party beneficiaries to sign the qualified conservation easement; and

(D) Provide a copy of the qualified conservation easement to ARB;

(21) Declaration that the offset project does not employ broadcast fertilization;

(22) If regeneration cuts or commercial harvesting is either planned or ongoing within the project area, indicate which option(s) the forest owner(s) and its affiliates will employ to demonstrate sustainable harvesting practices on all forest landholdings (refer to subchapter 3.1(a)(2));

(23) Description of how the offset project meets (or will meet) the natural forest management criteria (refer to table 3.1);

(24) *Description of the inventory methodology for each of the carbon pools included in the offset project boundary;

(25) Matrix documenting any and all legal constraints affecting forest management activities in the project area. Matrix must include:

(A) A description of each constraint;

(B) The applicable geographic range for each constraint and the local, state, or federal agency associated with each constraint;

(C) A narrative that describes the effect of the constraint on forest management, including disclosure of assumptions used for canopy retention and/or habitat conditions and identification of any required temporal conditions (e.g., 10% of inventory maintained as spotted owl habitat by 2030); and

(D) *A description of the modeling techniques used to simulate the effects of the constraint;

(26) *A general description of the modeling plan, identifying the ARB approved growth model to be used for the project;

(27) *Summary of the inventory of carbon stocks for each carbon pool;

(28) *Qualitative description and estimate of the forest project's baseline onsite carbon stocks;

(29) *Baseline onsite carbon stocks portrayed in a graph depicting time (100 years) in the x-axis and metric tons $CO_2e$ in the y-axis. The graph must be supported with written characterizations that explain any annual changes in baseline carbon stocks over time. The graph must include:

(A) The project's baseline;

(B) The project's common practice value (IFM projects only);

(C) The project's minimum baseline level (IFM projects only); and

(D) The project's initial above-ground standing live tree carbon stocks;

(30) *An estimate of carbon that will be stored long-term in harvested wood products in the baseline;

(31) *Calculation of the offset project's reversal risk rating;

(32) Declaration that the project is not being implemented and conducted as the result of any law, statute, regulation, court order, or other legally binding mandate? If yes, explain;

(33) Disclose if any GHG emission reductions associated with land within the project area have ever been:

(A) Listed or registered by another registry or program for the purpose of greenhouse gas mitigation or reduction goals, whether in a voluntary or regulatory context;

(B) Credited or claimed by another registry or program for the purpose of greenhouse gas mitigation or reduction goals, whether in a voluntary or regulatory context;

(C) Sold to a third party prior to listing;

(D) If yes to any of the above, identify the registry or program, reporting period(s), number of credits issued, vintage(s) of credits, and verification bodies that have performed verification services; and

(34) State whether the project is transitioning to the Compliance Offset Protocol U.S. Forest Projects, after previously being listed as an early action offset project.

**7.1.2. Reforestation Projects**

(a) In addition to the requirements of 7.1.1, reforestation projects must provide:

(1) Explanation of how the project area, at the time of offset project commencement, meets the eligibility requirements of: a) less than 10 percent tree canopy cover for a minimum of 10 years; or b) subject to a significant disturbance that has resulted in the loss of at least 20 percent of the area's standing above-ground live biomass. The explanation must include why the forest had been reduced to less than 10 percent tree canopy cover or a description of the disturbance if a significant disturbance occurred;

(2) For a reforestation project that occurs on land that has undergone a recent significant disturbance, indicate the eligibility scenario pertaining to the project site as identified in appendix E or a provide a description of how the forest project occurs on a type of land for which the forest owner(s) has not historically engaged in or allowed timber harvesting; and

(3) Qualitative characterization of baseline conditions, including an assessment of the likely vegetative conditions and activities that would have occurred in the absence of the project, taking into consideration any laws, statutes, regulations, or other legal mandates that would require reforestation on the project area. The qualitative characterization must include an assessment

of the commercial value of trees within the project area over the next 30 years.

### 7.1.3. Improved Forest Management Projects on Private Lands

(a) In addition to the requirements of 7.1.1, improved forest management projects on private lands must provide:

(1) Documentation demonstrating that the project area has greater than 10 percent tree canopy cover;

(2) A determination of how the forest project's initial above-ground standing live tree carbon stocks compare to common practice, as required in subchapter 5.2.1;

(3) If the forest project's initial above-ground standing live tree carbon stocks are below common practice, a determination of the "high stocking reference" for the project area. To determine the high stocking reference, changes in the project area's live-tree carbon stocks over the preceding 10 years must be documented;

(A) Include an affidavit testifying that the inventory depicted over the past 10 years is reasonably accurate; and

(B) Include a summary of volume harvested over the past 10 years;

(4) A description of how the growth and harvesting regime assumed for the baseline is financially feasible following the requirements of subchapter 5.2.1; and

(5) Identification of the following factors associated with development of the project's baseline:

(A) Weighted common practice value associated with the project area;

(B) Minimum baseline level (MBL) for the project area; and

(C) If initial above-ground standing live tree carbon stocks are below common practice, the WCS per acre for all forest owner(s) (and affiliate) landholdings within the same logical management unit as the project area, calculated per subchapter 5.2.1(d)(3). Indicate whether WCS was calculated using inventory data or stratified vegetation-type analysis.

### 7.1.4. Improved Forest Management Projects on Public Lands

(a) In addition to the requirements of 7.1.1, improved forest management projects on public lands must provide:

(1) Documentation demonstrating that the project area has greater than 10 percent tree canopy cover;

(2) Projection of future changes to project area forest carbon stocks in the project area by extrapolating from historical trends and anticipating how current public policy will affect onsite carbon stocks per the requirements of subchapter 5.2.2; and

(3) Documentation of current public policy, land use plans, and activity-based funding applicable to the project area. Documentation must include:

(A) A description of each element identified in (a)(3);

(B) A geographic location for each policy item and the local, state or federal agency associated with each element identified in (a)(3);

(C) A narrative that describes the effect of each element identified in (a)(3) on forest management, including disclosure of assumptions used for canopy retention and/or habitat conditions and identification of any required temporal conditions (e.g., 10% of inventory maintained as spotted owl habitat by 2030); and

(D) A description of the modeling techniques used to simulate the effects of each element identified in (a)(3).

### 7.1.5. Avoided Conversion Projects

(a) In addition to the requirements of 7.1.1, avoided conversion projects must provide:

(1) Documentation demonstrating the planned or completed dedicating of the land in the project area to continuous forest cover through a qualified conservation easement or transfer to public ownership;

(2) Documentation demonstrating that the type of anticipated land use conversion is legally permissible per the requirements of subchapter 3.4.1;

(3) A description of how the project area was determined, following the requirements in subchapter 2.3;

(4) A full copy of the appraisal that was prepared for the project area per the requirements of subchapter 3.4.2;
(5) A description of the highest value alternative land use identified in the appraisal;
(6) An estimate of the rate of conversion and removal of onsite carbon stocks per the requirements in subchapter 5.3.1;
(7) A comparison of the fair market value of the anticipated alternative land use for the project area with the value of the current forested land use, and the calculation of an appropriate avoided conversion discount factor (following the requirements in subchapter 5.3.1);
(8) Where the anticipated alternative land use is commercial, industrial, residential, or agricultural use, indicate the maximum slope of the project area;
(9) Where the anticipated alternative land use is mining, describe the extent of mineral resources existing in the project area; and
(10) Where the anticipated alternative land use is commercial, industrial, residential or recreational use, indicate:
    (A) The proximity of the project area to metropolitan areas;
    (B) The proximity of the project area to grocery and fuel services and accessibility of those services; and
    (C) Population growth (people per year) within 180 miles of the project area.

**7.2. Offset Project Data Report**

(a) The Offset Project Operator or Authorized Project Designee must submit Offset Project Data Reports for each year of the project life according to the reporting schedule in section 95976 of the Regulation.
(b) A forest project is considered automatically terminated if the Offset Project Operator or Authorized Project Designee does not report data at required intervals.

(c) The listing information in subchapter 7.1 must be included in the initial Offset Project Data Report, and is subject to verification at the initial and all subsequent offset project verifications.

(d) Reforestation projects as qualified in subchapter 5.1.1(b)(2) can defer the items that are marked with an asterisk until submission of the Offset Project Data Report that will undergo the second site-visit verification. Reforestation projects for which an initial inventory is deferred are not eligible to receive ARB or registry offset credits until after the second verification.

(e) All documents that reference carbon stocks must be submitted with the oversight of a Professional Forester. If the offset project is located in a jurisdiction without a Professional Forester law or regulation, then a Professional Forester must either have the Certified Forester credentials managed by the Society of American Foresters, or other valid professional forester license or credential approved by a government agency in a different jurisdiction.

(f) The Offset Project Operator or Authorized Project Designee must provide the Offset Project Data Report(s) undergoing verification to a verification body at least ten working days prior to the start of any scheduled verification site visit.

**7.2.1. Annual Reporting**

(a) The Offset Project Operator or Authorized Project Designee must submit the information required by section 95976 of the Regulation and the following information:

(1) Offset project name;

(2) ARB project ID number;

(3) Offset project type (reforestation, improved forest management, or avoided conversion);

(4) Contact information, including name, phone number, mailing address, physical address (if different from mailing address) and email address for:

(A) Offset Project Operator;

(B) Authorized Project Designee (if applicable);

(C) The person submitting the information; and

(D) Any technical consultants;

(5) CITSS ID number for the:
    (A) Offset Project Operator; and
    (B) Authorized Project Designee (if applicable);
(6) Date OPDR completed;
(7) Reporting period start and end dates;
(8) Statement as to whether the forest project and associated project lands have met and been in compliance with all local, state, or federal regulatory requirements during the reporting period. If not, an explanation of the non-compliance must be provided;
(9) Statement as to whether all the information submitted for project listing is still accurate. If not, provide updates to the relevant listing information;
(10) *Updated estimate of the project area's carbon stocks for each of the required carbon pools. The estimate must reflect the appropriate confidence deduction as determined by appendix A;
(11) *The appropriate confidence deduction for the forest carbon inventory following the requirements and methods in appendix A;
(12) *An explanation of any decrease over any 10 consecutive year period in the standing live tree carbon pool;
(13) Any changes in the status of the forest owner(s) including, if applicable per subchapter 3.1, the acquisition of new forest landholdings;
(14) A description of how the project meets, or will meet, the natural forest management criteria (refer to table 3.1), including progress on criteria that have not been fully met in previous reporting periods;
(15) *An estimate of reporting period harvest volumes (may be reported in $tCO_2e$ or tCO2e/acre as appropriate) and associated carbon in harvested wood products;
(16) *Estimated mill efficiency, as determined following the method in appendix C;
(17) The baseline carbon stock estimates for all required carbon pools for the reporting period, as determined following the requirements in chapter 5 and approved at the time of the project's initial verification;

(18) *An estimate of secondary effects, following calculation steps and/or factors provided in chapter 5;

(19) The avoided conversion discount factor, as determined following the requirements of subchapter 5.3.1 and approved at offset project's initial verification;

(20) A calculation of total net GHG emission reductions and GHG removal enhancements ($QR_y$ in equation 5.1) for the reporting period, following the requirements in chapter 5;

(21) If a reversal has occurred during the previous reporting period, the report must include a written description and explanation of the reversal, whether the reversal has been classified as intentional or unintentional, and the status of compensation for the reversal;

(22) *The offset project's reversal risk rating, as determined following the requirements in appendix D;

(23) *A calculation of the offset project's forest buffer account contribution; and

(24) *The initial Offset Project Data Report must also include the following as separate attachments:

(A) Projections of baseline and actual harvesting volumes from the project area over 100 years (may be reported in $tCO_2e$ or tCO2e/acre as appropriate);

(B) If the forest project is located on public land, provide documentation demonstrating explicit approval of the offset project's management activities and baseline including any public vetting processes necessary to evaluate management and policy decisions concerning the offset project;

(C) The complete carbon inventory methodology that meets the requirements of appendix A (to be submitted as a separate document);

(D) The complete modeling plan methodology that meets the requirements of appendix B (to be submitted as a separate document); and

(E) The final baseline incorporating all required carbon pools portrayed in a graph depicting time (100 years) in the x-axis and metric tons $CO_2e$ in the y-axis. The graph must be supported with written

characterizations that explain any annual changes in baseline carbon stocks over time.

### 7.2.2. Additional Reporting for Verification Years

(a) Forest projects must be verified at least every six years.

(b) If verification is less frequent than annual, Offset Project Data Reports must include the following additional information:

(1) Annual estimates of the project area's carbon stocks for each of the required carbon pools reported during each reporting period since the last verification. The estimates must reflect the appropriate confidence deduction as determined by appendix A;

(2) Confidence deduction for the forest carbon inventory applied for each reporting period since the last verification for the project, if applicable;

(3) Baseline carbon stock estimates for all required carbon pools reported during each reporting period since the last verification;

(4) Estimate of harvest volumes and associated carbon in harvested wood products reported during each reporting period since the last verification;

(5) Estimate of secondary effects reported during each reporting period since the last verification;

(6) If a reversal has occurred it must be reported within 30 calendar days of its discovery pursuant to Section 95983(b) and 95983(c)(1) of the Regulation. The report must provide a written description and explanation of the reversal, whether the reversal has been classified as intentional or unintentional, and the status of compensation for the reversal;

(7) Calculation of the offset project's forest buffer account contribution for each reporting period since the last verification; and

(8) Calculation of total net GHG emission reductions and GHG removal enhancements ($QR_y$ in equation 5.1) reported for each reporting period since the last verification.

## Chapter 8. Verification

(a) Offset Project Data Reports must be verified for the duration of the project life in accordance with the regulatory verification requirements in subarticle 13 of the Regulation and this protocol.

(b) Except as allowed for the second verification of reforestation projects, ARB requires that an ARB-accredited third-party verification body review and assess all reported data and information for a forest project and conduct a site visit at least once every six years.

(c) The Offset Verification Statement for the initial reporting period must be received by ARB or an Offset Project Registry within 13 months after the conclusion of the Reporting Period for which offset verification services were performed. An Offset Verification Statement for all subsequent reporting periods must conform with the timing for submittal of Offset Verification Statements found in section 95977 of the Regulation.

(d) If the inventory for a reforestation project is deferred as allowed for in subchapter 5.1.1(b)(2), the timing of the second verification is at the discretion of the Offset Project Operator or Authorized Project Designee but must occur within 12 years of the initial verification. Reforestation projects for which an initial inventory is deferred are not eligible to receive ARB or registry offset credits until after the second verification.

(e) Less intensive verification services may be provided in interim years between full verification at the discretion of the Offset Project Operator or Authorized Project Designee, subject to the concurrence of the accredited verification body that conducted the last full verification.

(f) Less intensive verification is not allowed if:

  (1) There have been significant changes in methodologies or updates to the forest carbon inventory program;

  (2) There has been a change in verification body since the previous verification;

  (3) The forest project is reporting a change to the confidence deduction; or

  (4) There has been a change to the forest project's reversal risk rating as a result of undertaking fuel treatments to reduce the risk of wildfire.

(g) At least a less-intensive verification is required anytime there is a change to the forest project's reversal risk rating as a result of employing a qualified conservation easement.

(h) Forest projects are not eligible to receive a qualified positive offset verification statement.

(i) Failure to conform to any requirements in this protocol or the Regulation, as applicable, will result in an adverse verification statement.

(j) A forest project is considered automatically terminated if the project does not undergo verification at required intervals.

### 8.1. Full Verification

(a) Once a full verification begins, changes and/or additions may be made to the inventory, methodology, or modeling in response to the findings of the verifier. A verifier may determine that a follow-up site visit is required to assess the appropriateness of these changes. An updated Offset Project Data Report must be provided to the verification body at least ten working days prior to any follow-up site visit.

(b) In addition to the offset project verification requirements in the Regulation, verification of Offset Project Data Reports for forest projects must include:

(1) During the initial full verification, a detailed review of:

(A) All required listing including documentation and maps to verify the boundaries and acreage of the project area enrolled in a forest project;

(B) The complete inventory methodology; and

(C) The modeling plan, assumptions, and silvicultural prescriptions applied to produce the project baseline; and

(2) During every full verification, including the initial verification, the following is required of the offset verifier:

(A) A detailed review of the forest carbon inventory, including:

1. Inventory methodology and sampling design;
2. Inventory update processes;
3. Measurement of sample plots and sample plot locations;
4. Lifetime and updating of sample plots, as applicable;

5. Stratification methods, if applicable;
6. Biomass equations and calculations;
7. Incorporation of growth and harvest modeling and data; and
8. Documentation of inventory methods and procedures, including procedures for data quality assurance and quality control;

(B) Review of application of appropriate confidence deductions, if applicable;

(C) Review reversal risk rating calculation;

(D) Review of conformance with natural forest management criteria and sustainable harvesting requirements, if applicable;

(E) Evaluate conformance with harvest unit size and buffer area requirements found in subchapter 3.1(a)(4), if applicable. The following procedure shall be used to determine if point count stocking standards have been met allowing for harvest of adjacent plots:

1. There shall be at least one plot per acre, with a minimum of 20 plots, for each harvest unit area sampled.
2. Plots shall be placed on the area being sampled in a uniform grid. The grid shall be considered uniform if the distance between lines does not exceed by two and one half times the distance between plots on the lines.
3. Roads and landings that will not be regenerated, meadows, wet areas, rocky areas, and areas not normally bearing timber shall not be used as plot centers for sampling purposes. Stream protection zones may be excluded from the sample where stocking cannot be achieved due to legal restrictions on regenerating the zone. A random right/left offset from the plot center may be used. Alternatively the plot may be treated as an unstocked plot for purposes of determining acceptable stocking. Offsets shall be in one-half chain (33 ft.) (10.06m) intervals at a right angle to the plot line with a maximum distance of 1.5 chain.
4. For trees counted as one point each, a plot with a 9.61 foot radius is used (1/150th of an acre). If a countable tree of a value of at

least one point is found in the plot, it is stocked, so recorded, and the verifier moves on to the next plot center. If no countable tree is found, the next concentric plot is measured.

5. For trees counted as three points each, a plot with a 16.65 foot radius is used (1/50th of an acre). If a countable tree of a value of at least three points is found in the plot, it is stocked, so recorded, and the verifier moves on to the next plot center. If no countable tree is found, the next larger concentric plot is measured.
6. For trees counted as six points each, a plot with a 23.55 foot radius is used (1/25th of an acre). If a countable tree of a value of at least six points is found in the plot, it is stocked. If no countable trees of the required sizes are found in the three concentric plots, the plot center is recorded as being unstocked and the verifier moves on to the next plot center.
7. No more than five unstocked plots shall be contiguous to each other. A contiguous unstocked plot is any plot within the rectangle constructed around the two adjacent plots on the same line and the three plots adjacent to them on the two nearest lines. If there are more than five unstocked plots contiguous to each other, the sample shall be assumed to be understocked except where application equation 8.1 gives a number of less than six.

**Equation 8.1. Contiguous Understocked Plot Analysis**

$$\frac{CUP \times SA}{NPS} - \frac{SIP \times 0.5 \times SA}{NPS} < 6$$

*Where,*

| | | |
|---|---|---|
| *CUP* | = | Number of contiguous unstocked plots |
| *SA* | = | Acres in sample area |
| *SIP* | = | Number of stocked intermediate plots. An intermediate plot is a plot placed halfway between two unstocked plots in the sample. |
| *NPS* | = | Number of plots in sample, excluding intermediate plots. |

8. If less than 55% of the plots are stocked, it is assumed that the area being sampled is understocked. If the OPO/APD or verifier

still believes the area to be stocked, another sample may be run. The second sample shall be laid out in the same manner as the first sample with the additional plots lying halfway between the initial plot lines. For statistical analysis, the two samples shall be combined and analyzed together.

(F) Projects that fail to meet the size and adjacency requirements during any full verification cannot receive a positive offset verification statement for that reporting period until the project is found to be in compliance with the size and retention requirements described in this section;

(G) Review documentation and data supporting the information reported in the Offset Project Data Report; and

(H) Use of sequential sampling methodology to verify forest carbon inventories following the methods in subchapter 8.1.1.

**8.1.1. Sequential Sampling**

(a) The offset verifier must re-measure existing monumented sample plots when plot locations within a project area can be found and it is statistically appropriate. If more than 10.00% of a project area's sample plots cannot be located or measurement of project sample plots is not statistically appropriate, the verifier must install sample plots independent of the project's sample plots. If a monumented sample plot within the allowable 10.00% cannot be located, the verifier must move to the next sequential randomly selected plot. The verification approach will determine whether a paired or unpaired test will be used by the verifier.

(b) The verification procedures described below must be applied independently for each applicable carbon pool or applicable combination of pools that are included in the offset project boundary:

(1) Standing live and dead trees;

(A) If the Offset Project Operator or Authorized Project Designee did not combine sample data for standing live and standing dead trees, the

offset verifier must conduct the analysis for standing live and standing dead trees independently;

(B) If the Offset Project Operator or Authorized Project Designee combined the measurement of standing live and standing dead trees, the offset verifier will analyze the combined pools; and

(C) If the Offset Project Operator or Authorized Project Designee combined standing live and standing dead trees and the offset verifier's finding for that combined pool does not trend toward agreement with the Offset Project Operator's or Authorized Project Designee's data, the carbon pools may not be disaggregated unless the Offset Project Operator or Authorized Project Designee revises the inventory to disaggregate the pools and a new set of sampling occurs by the verifier to determine agreement for each pool independently.;

(2) Shrubs and herbaceous understory (only applicable to reforestation projects); and

(3) Soil (if the project meets the threshold to include soil carbon due to site preparation, see tables 4.1, 4.2, and 4.3).

(c) The offset verifier must determine for each applicable pool or combination of pools if the Offset Project Operator or Authorized Project Designee has stratified the project area into strata that reflect common characteristics that influence carbon stocks.

(1) When a carbon pool or combination of pools have been stratified into five or less strata for the purposes of estimating the forest project's inventory, the offset verifier must select three strata, or the maximum number of strata if less than three, based on the offset verifier's evaluation of risk.

(2) When a carbon pool or combination of pools have been stratified into six or more strata for the purposes of estimating the forest project's inventory, the offset verifier must select a minimum of three strata, based on the offset verifier's evaluation of risk. The strata selected for sampling must represent a total sum of at least 50% of the total sum of carbon stocks measured in $CO_2e$. Sampling of more than three strata may be required.

(3) Selection of strata must be based on the following:

(A) The offset verifier must weigh risk and efficiency based on appropriate criteria. The offset verifier may presume risk exists in the highest stocked stratum, strata that are unique or difficult to access due to topographical, vegetative, or other physical barrier, strata where health and disease could impact the project's inventory, strata that represent a large portion of the project's inventory due to the area they represent, the vegetation heterogeneity of strata, or any other risk perceived by the offset verifier;

(B) The determination of risk must be applied to the stratum as a unit and not individual stands of a given stratum; and

(C) Consideration of risk must be based on the overall importance of a given stratum to the project's total stocks and the presumption that any given stratum is inaccurately measured.

(4) If the project area has not been stratified or there are less than 3 strata, the offset verifier must locate the plots or clusters using a process of their own design consistent with the objectives of a random, risk-based, and efficient approach.

(d) Selection of stands for both paired and unpaired tests must be based on the following:

(1) The offset verifier will query, or request that the Offset Project Operator or Authorized Project Designee query, the set of stands that are associated with the strata selected;

(2) The queried stands must have an identifier which can be based on the Offset Project Operator or Authorized Project Designee's identification convention or one assigned by the offset verifier;

(3) Stands within a given stratum must be independently selected using a random selection design; and

(4) The selected stands must be mapped and labeled with the random number to assist in developing a strategy to perform field sampling activities.

(e) Selection of verification plots must be based on the following:

(1) The offset verifier will sample plots consistent with the objectives of a random, risk-based and efficient approach;

(2) Verification plots must reflect the variability in tree species, heights, and diameters existing in the project area;

(3) The offset verifier may choose to sample project plots within a stand using clustering or systematic approaches to facilitate efficiency. If the offset verifier uses a cluster design, the mean of the cluster accounts for one observation (plot);

(4) Plots, or clusters, must be independently selected within a strata using a random or systematic design. If the offset project is not stratified for each applicable carbon pool, the offset verifier must allocate the plots or clusters on a randomized basis;

(5) No more than 6 plots or clusters can be assigned to a stand, unless the groups of plots required for verification exceed the number of stands that exist for the offset project; and

(6) The minimum number of sample plots varies by project size and number of strata (table 8.1). The number of plots necessary for agreement may require additional plot measurements beyond the minimum required and may differ by stratum.

**Table 8.1. Minimum number of sample plots in sequence, as a function of project size**

| Test | Number of Strata | Project Acres | | | | |
|---|---|---|---|---|---|---|
| | | <100 | 100 - 500 | 501 - 5,000 | 5,000 - 10,000 | >10,000 |
| Paired/Unpaired | 6+ | 3 | 3 | 4 | 4 | 5 |
| | 3-5 | 3 | 3 | 4 | 5 | 6 |
| | 2 | 4 | 6 | 8 | 10 | 12 |
| | 1 | 8 | 12 | 16 | 20 | 24 |

(f) Plots or clusters must be measured as follows:

(1) Plots may be measured and assessed one at a time or in reasonable batches that correspond to logistical realities such as crew-days of effort;

(2) For efficiency, it is acceptable for the offset verifier to relocate to a new area at the beginning of a day without having completed all the plots in the previous day;

(3) It is required that the offset verifier apply the random order selection in the sampling process. For efficiency purposes, the offset verifier may skip the

random order on a temporal basis as long as the sequential analysis includes the ordered set of stands. This may provide significant efficiencies when selected stands and/or plots are in close geographic proximity and it is hypothesized that the stopping rules will require the full number of plots; and

(4) All tree heights in plots selected for sequential sampling must be measured. Verifiers may not use regression estimators nor estimate heights in place of plot-based field measurements of heights.

(g) Sequential approaches have stopping rules rather than fixed sample sizes to indicate a successful agreement. With each successive plot or series of plots analyzed by the offset verifier, the stopping rules indicate to the offset verifier to:

(1) Continue to the next plot(s) since the results do not indicate either a bias or an agreement and further testing is required;

(2) Stop as the testing indicates bias; or

(3) Stop as the testing indicates agreement.

(h) For effective application of the sequential statistics in the field, the offset verifier must use their discretion to determine if the stopping rules have been met for each stratum:

(1) After the measurement of each plot;

(2) After the minimum number of plots per stratum are collected;

(3) After sampling additional plots, as determined to be necessary by the offset verifier and agreed upon with the Offset Project Operator or Authorized Project Designee; or

(4) The verifier may defer the determination until no later than the end of each day of sampling, which will include the full set of plots measured in that day.

(i) When a stopping rule is met then the result is evaluated.

(1) Verification is successful after a minimum number of successive plots in a sequence indicate agreement within the specified tolerance bounds described in subchapter 8.1(k) and no bias is detected.

(2) Where the stopping rules indicate the presence of a bias, additional verification plots may be collected after that time if it is felt that random chance may have caused the test to fail and a convergence towards agreement is expected with additional samples.

(j) There are two possible statistical procedures that can be applied to the sequential sampling data. A paired test must be used when existing monumented sample plots were re-measured. An unpaired test must be applied when plots installed by the verifier were measured.

(k) The range of acceptable error (δ, delta) is fixed at 10 percent. If, through repeated verification effort, the carbon estimate does not pass the sequential sampling methodology with an acceptable range of error, the verifier must provide an opportunity for the Offset Project Operator to correct the error through an amendment to the Offset Project Data Report and/or inventory prior to issuing an adverse verification statement.

(l) Because each stratum is tested independently, it is possible for a project with multiple strata to partially pass the paired or unpaired test (i.e., one or more stratum passes the sequential sampling test while one or more stratum does not). In this case:

(1) A verification body must allow the Offset Project Operator or Authorized Project Designee to correct errors in the strata that do not pass the sequential sampling test; and

(2) If the Offset Project Operator or Authorized Project Designee chooses to re-inventory the strata that did not pass or take similar action in order to correct the issue, the verifier must conduct a follow-up site visit to:

(A) Re-sample the strata with new plots selected using the methodology of subchapter 8.1.1; and

(B) Apply the sequential sampling technique per subchapter 8.1.1;

(3) If randomization results in the inclusion of plots that have already been sampled during a previous site visit and that information has been shared with the Offset Project Operator, Authorized Project Designee, forest owner(s) or its affiliates during that site visit, the offset verifier must indicate they have tested for bias; and

(4) If any changes are made to the inventory of strata that previously passed sequential sampling, the appropriateness of those changes must be evaluated by the verifier prior to completion of verification services and may warrant a subsequent site visit.

#### 8.1.1.1. Paired Plots

(a) The statistical test for paired plots is based on a comparison of the verifier's measurements of plots within a selected stratum, calculated as $CO_2e$ compared to the Offset Project Operator's or Authorized Project Designee's measurements of plots, which may include any adjustments for growth.

(b) The verifier must use alpha (α) = 0.05 and beta (β) = 0.20.

(c) The null hypothesis ($H_0$) is that the verifier's plots and project plots are equal.

(d) The following procedure is appropriate for the paired test and must be utilized by verifiers:

(1) Sample and measure at least the minimum number of plots required in table 8.1;

(2) Use equation 8.2 to determine if stopping rule has been met;

**Equation 8.2. Stopping Rule for Paired Plots**

*Evaluate:* $[(Z_\alpha + Z_\beta)^2 \times S_n^2] / D^2$

*Where,*

| | | |
|---|---|---|
| $Z_\alpha$ | = | α/2% N(0,1) = 1.645 |
| $Z_\beta$ | = | β/2% N(0,1) = 0.8416 |
| $S_n^2$ | = | Sample variance of the differences |
| D | = | δ × stratum average estimate |
| δ | = | 0.10 |
| n | = | Number of verification plots measured |

If result ≤ n, then stop and evaluate results using equation 8.3
If result > n, then take another sample

(3) If stopping rule is met, evaluate results using equation 8.3;

**Equation 8.3. Evaluation of Null Hypothesis for Paired Plots**

*Evaluate:* $(Z_\alpha \times D) / (Z_\alpha + Z_\beta)$
*And:* $|\bar{X}_N|$

*Where,*

| | | |
|---|---|---|
| $Z_\alpha$ | = | α/2% N(0,1) = 1.645 |
| $Z_\beta$ | = | β/2% N(0,1) = 0.8416 |
| D | = | δ × stratum average estimate |
| δ | = | 0.10 |
| $\lvert \bar{X}_N \rvert$ | = | Absolute value of sample mean of the differences |

If $|\bar{X}_N| \leq (Z_\alpha \times D) / (Z_\alpha + Z_\beta)$, then accept $H_0$
If $|\bar{X}_N| > (Z_\alpha \times D) / (Z_\alpha + Z_\beta)$, then reject $H_0$

(4) If $H_0$ was rejected then additional samples may be taken as long as the offset verifier is of the opinion that there is a chance that $H_0$ may be accepted based on the variability and trend observed.

**8.1.1.2. Unpaired Plots**

(a) The statistical test for unpaired plots is based on a comparison of the average $CO_2e$ estimates for each stratum between the verifier plots and the Offset Project Operator's or Authorized Project Designee's plots.

(b) The null hypothesis ($H_0$) is that the verifier's and project's averages are equal.

(c) The offset verifier must use α=0.05 to control for error; the β is not specified because the method is constructing a confidence interval rather than a test.

(d) The following procedure is appropriate for the unpaired test and must be utilized separately for each stratum by verifiers:

(1) Sample and measure at least the minimum number of plots required in table 8.1;

(2) Use equation 8.4 to determine if stopping rule has been met;

**Equation 8.4. Stopping Rule for Unpaired Plots**

*Evaluate:* $(a^2/D^2) \times (S_n^2 + S_P^2)$

*Where,*

| | | |
|---|---|---|
| a | = | The percentile from a standard normal distribution for one half of alpha; is 1.96 for α=0.05 |
| D | = | δ × Stratum average estimate |
| δ | = | 0.10 |
| $S_n^2$ | = | Sample variance of the differences |
| $S_P^2$ | = | Sample variance of the stratum plots |
| n | = | Number of verification plots measured (Note: $n = n_P + n_V$) |

If result < n, then stop and evaluate results using equation 8.5
If result ≥ n, then take another sample

(3) If stopping rule is met, evaluate results using equation 8.5;

**Equation 8.5. Evaluation of Null Hypothesis for Unpaired Plots**

*Construct a confidence interval for:* $T_n \pm D$

*Where,*

| | | |
|---|---|---|
| $T_n$ | = | $\bar{x}_p - \bar{x}_n$ |
| $\bar{x}_p$ | = | Stratum mean |
| $\bar{x}_n$ | = | Verification mean after sample n |

| | | |
|---|---|---|
| D | = | δ × Stratum average estimate |
| δ | = | 0.10 |
| $\lvert \bar{X}_N \rvert$ | = | Absolute value of sample mean of the differences |

If the confidence interval includes zero, then accept $H_0$
Otherwise, reject $H_0$

(4) If $H_0$ was rejected then additional samples may be taken until as long as the verifier is of the opinion that there is a chance that $H_0$ may be accepted based on the variability and trend observed; and

(5) If the stopping rule cannot be met within 100 plots, then apply a standard unpaired t-test comparison using alpha of 0.05 and beta of 0.80.

### 8.2. Less-Intensive Verification

(a) A less intensive verification of an Offset Project Data Report only requires data checks and document reviews of an Offset Project Data Report based on the analysis and risk assessment in the most current sampling plan developed as part of the most recent full offset verification services.

(b) A less intensive verification does not require a site visit.

(c) This level of verification may only be used if the verification team can provide findings with a reasonable level of assurance.

(d) During less intensive verification of forest projects, the verification team must:

(1) Conduct data checks and carefully review data and calculations contained within the Offset Project Data Report; and

(2) At a minimum, review documentation supporting the data and calculations in the Offset Project Data Report, including:

(A) The data used to update the forest carbon inventory and any new sample plot measurements;

(B) Updates in growth and yield models;

(C) Updates to timber harvest plans and other regulatory documentation related to timber harvest; and

(D) Documentation of timber sales.

### 8.3. Verification of Multiple Reporting Periods

(a) If verification is less frequently than annual, the verification team must:

(1) Review and evaluate reported data specified in subchapter 7.2.2 separately for each reporting period; and

(2) Issue individual Offset Verification Statements for each reporting period.

### 8.4. Verification Team

(a) Each verification team must include the following:

(1) At least one professional forester that takes an active role in reviewing the forest carbon inventory program and conducting the site visit;

(2) At least one individual with demonstrated competence in forest biometrics through:

(A) A master's degree in statistics or forest biometrics, or another closely related science that includes 12 semester or 16 quarter hours of forest biometrics, sampling design and/or statistics coursework; or

(B) University coursework that includes 12 semester or 16 quarter hours of forest biometrics, sampling design and/or statistics coursework, and at least two years of experience sampling, developing, implementing and analyzing forest biomass or carbon inventories;

(3) At least one individual with demonstrated knowledge of and competence in the use of forest growth and yield models, and demonstrated experience working with the model used in the forest carbon inventory being verified. Such experience must include at least two years of university or other professional coursework and/or project experience demonstrating competency in the use of the model; and

(4) An ARB-accredited Forest Offset Project Specialist.

(b) An explanation demonstrating that the verification team includes individuals with the required experience and expertise must be included in the Notice of Verification Services.

(c) The required experience and expertise may be demonstrated by a single individual, or by a combination of individuals.

## Appendix A. Developing an Inventory of Forest Project Carbon Stocks – Quantification Methodology

A forest project's carbon inventory is used as the basis for modeling and estimating carbon stocks in a forest project's baseline (following the requirements of chapter 5 and appendix B) and used to quantify actual carbon stocks during the project life (following the requirements of chapter 5). Offset Project Operators or Authorized Project Designees must perform the following steps when developing the forest project's carbon inventory:

(a) Describe and document the activities and land use patterns that influence carbon stocks in the project area. This information will be reviewed during verification and should be used to help inform the initial design of the forest inventory and the estimations of carbon stocks. Include descriptions of:
   (1) Species composition;
   (2) Vegetation types;
   (3) Age class distribution;
   (4) Topography;
   (5) Land pressures;
   (6) Climate;
   (7) Harvesting practices employed;
   (8) Management history and planned management activities;
   (9) Known or potential disease(s) that may affect the health of the trees in the project's inventory, specifically above-ground standing live and dead trees;
   (10) Legal and financial constraints;
   (11) Ownership structure; and
   (12) Existence of conservation easement(s).

(b) Develop and document a carbon inventory methodology. The Offset Project Operators or Authorized Project Designee is responsible for determining appropriate sampling methodologies for each required carbon pool. Inventory methods must be capable of quantifying carbon stocks for required onsite carbon pools to a high degree of accuracy. All sampling methods and measurement standards must be statistically sound and must be reviewed for statistical validity

and conformance during verification. A complete carbon inventory methodology must include:

(1) A description of the Offset Project Boundary and a list of all onsite carbon pools included in the Offset Project Boundary (see tables 4.1, 4.2, and 4.3 to determine which onsite carbon pools are included and quantified from inventory measurements);

(2) Stratification rules (pre- and post-sampling), if applicable, that include a map of vegetation strata, results of stratification (area by strata), tools for application (such as GIS, aerial photos, etc.), and a description of how boundaries were determined (stratification is not required, but it may simplify verification);

(3) The types of sample plots, plot layout, and location of plots and description of monumenting procedures;

  (A) Temporary flagging of plot center, as is customary to allow for check cruising, is required to ensure ongoing inventory quality and allow for offset verifiers to visit plots when verifying inventory procedures;

  (B) If permanent plots are used, which are statistically efficient for stock change estimates, permanent plot monumenting must be sufficient for relocation; and

  (C) Plot centers must be referenced on maps, preferably with GPS coordinates;

(4) Standards for tree and plot size;

(5) Forest carbon inventory methodology and sampling procedures for each required onsite carbon pool, with references clearly documented. These procedures must be detailed enough so that any qualified forester would be able to accurately repeat the previous measurements and must include descriptions of:

  (A) Tools used for height measurement, diameter measurement, and plot measurement;

  (B) Where and how to measure parameters used in volume and biomass equations, models, and associated calculations such as DBH and

height (including for irregular trees). These procedures must be consistent with the requirements in table A.1;

(C) How structural loss is assessed when standing live and standing dead trees are missing biomass (cavities, broken tops, or other deformities that reduce biomass in trees);

(D) How to classify dead wood; and

(E) Any other aspects of sampling where a consistent method needs to be documented;

(6) The frequency for updating or replacing sample plots and the forest carbon inventory as a whole;

(A) Any plot data used for deriving the forest carbon inventory estimates have been sampled within the last 12 years;

(B) The scheduling of plot sampling may occur in one time period or be distributed over several time periods;

(C) Either approach is acceptable so long as an inventory of the entire project area (its required carbon pools and corresponding sample plots) is completed within 12-year intervals;

(7) Description of data management systems and processes, all analytic methods, calculation methodologies, volume and biomass equations and models used to translate field measurements into volume and/or biomass and carbon estimates for each of the carbon pools included in the offset boundary;

(8) A documented quality assurance/quality control (QA/QC) plan including procedures for internal review to ensure that standard operating procedures are being followed. The QA/QC plan must include procedures for:

(A) Assessing and ensuring the quality of data collection;

(B) Transfer and archiving of field data;

(C) Procedures for data entry and analysis and data maintenance and archiving; and

(D) Any other relevant procedures to ensure quality and consistency in the collection and maintenance of data used to compile Offset Project Data Reports;

(9) A change log documenting any changes in the inventory methods or volume and biomass equations used to calculate carbon stocks; and

(10) Standard procedures for updating the forest carbon inventory, including documented procedures to account for:

(A) Harvest;

(B) Growth;

(C) Mortality;

(D) Disturbance;

(E) Incorporating new inventory and plot data;

(F) Retiring older sample plots;

(G) Changes in modeling, as allowed under appendix B; and

(H) Application of appropriate confidence deduction.

**Table A.1. Minimum Requirements for Field Measurements**

| Carbon Pool | Requirement | Description of Requirement |
|---|---|---|
| Standing Live Tree Carbon Stocks | Tree Selection | All tree species within the project area must be measured regardless of the merchantability of the trees. |
| | Diameter at Breast Height | The minimum diameter at breast height must be stated in the methodology and must not be greater than 5 inches. |
| | Height Measurements | Heights must be measured as per the inputs required by the volume models and/or biomass equations for each species and re-measured during subsequent updates to the inventory. If the project's growth and yield model imputes heights utilizing the model's own data points (but accepts measured height), height measurements collected in the field or derived from field inventory must be used in the model. In interim years when inventory data is modeled, DBH and height estimate outputs from the model may be used as the basis for carbon calculations. A portion of heights may be estimated as long as the height estimate methodology and overall inventory method employed results in an inventory that is capable of being quantified at the plot level to a high degree of accuracy, designed such that any qualified forester would be able to accurately repeat the previous measurements, whereby the verifier reviews the inventory sampling methodology and agrees that all sampling methodology and measurement standards are statistically sound. All field measurements within a project area are subject to passing sequential sampling and verification. |
| | Missing Biomass | Standing live trees may have cavities, broken tops, or other deformities that reduce biomass in the trees. Inventory methodology must include a standardized approach and description of how deductions are estimated to account for missing biomass. Parameters required to adjust biomass accordingly must be collected during field measurements. |
| Standing Dead Tree Carbon Stocks | Merchantability of Trees | All tree species within the project area must be measured regardless of the merchantability of the trees. |
| | Diameter at Breast Height and Top Diameter | The minimum diameter at breast height must be stated in the methodology and must not be greater than 5 inches. The minimum height of standing dead trees is 15'. The method must include how volume is derived where a total height does not exist (i.e., where the tree is broken). |

| | | |
|---|---|---|
| | Measurements | |
| | Height Measurements | Height must be measured as per the inputs required by the volume models and/or biomass equations for each species and re-measured for subsequent updates to the inventory. |
| | Missing Biomass | Standing dead trees may have cavities, broken tops or other deformities that reduce biomass in the tree. Inventory methodology must include a standardized approach and description of how deductions are estimated to account for missing biomass. For projects in California, Oregon, Washington, and Alaska adjustments for decay and structural loss must be incorporated in the sampling design and reflected in the project inventory accounting methodology, using Harmon et al (2011) decay class. For projects in the other 45 states, adjustments for decay and structural loss must be incorporated in the sampling design and reflected in the project inventory accounting methodology using Domke et al (2011) decay and structural loss adjustment factors for projects using the Component Ratio Method (CRM). |
| Shrubs and Herbaceous Understory | Sampling Methodology | The most applicable biomass estimation methods may be used, including photo series, the estimation functions from published papers, direct sampling, or combinations of approaches. Projects may use the sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004) or an alternative methodology. Alternative methodologies need to be reviewed and approved by ARB and verified by the verification body. |
| Soil Carbon | Sampling Methodology | Use the soil sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004). |

(c) Inventory methods and sampling procedures, once established and approved at verification, must be consistent over the life of the project. If new methodologies are adopted, they must achieve an equal or greater accuracy relative to the original sampling design. Any changes to inventory methods or calculations must be documented and justified in the change log.

(d) Conduct the field inventory per the carbon inventory methodology. If a pre-existing forest inventory is used to develop a forest carbon inventory, all steps in this appendix must be followed to ensure the existing inventory meets the requirements of this protocol.

(e) Offset Project Operators or Authorized Project Designees must keep a distinct inventory for each required carbon pool. Reforestation projects must further distinguish between pre-existing trees and planted trees when inventorying standing live carbon; pre-existing trees do not need to be inventoried until the offset project first seeks verification of GHG emission reductions and GHG removal enhancements.

(f) Estimate the carbon in the above-ground portion of standing live trees[5]:

[5] Biomass equations for the Alaska region directly estimate biomass and carbon and do not require tree volume to be computed prior to converting to biomass and carbon mass estimates.

(1) Apply allometric equations provided on the Forest Offset Protocol Resources section of ARB's website to estimate volume and biomass from the DBH and height measurements;

(2) Adjust the calculation for standing live trees to account for missing portions (i.e., cavities, broken tops or other deformities) according to the methods described in the Offset Project Operator's or Authorized Project Designee's carbon inventory methodology;

(3) Multiply the derived estimate of biomass by 0.5 to calculate the mass (kg) in carbon. This product must be multiplied by 0.001 tons/kg to convert the mass to metric tons of carbon. This product must be multiplied by 3.667 to convert to MT $CO_2e$; and

(4) Calculate the carbon in above-ground standing live trees in MT $CO_2e$/acre.

(g) Estimate the carbon for the above ground portion of standing dead trees[6], adjusting for structural loss in standing dead trees. Apply allometric equations provided on the Forest Offset Protocol Resources section of ARB's website to estimate carbon in standing dead trees in advanced stages of decay by:

(1) Estimating the gross and sound volume from field measurements;

(2) Converting sound volume to biomass;

(3) Converting biomass in each tree component to carbon; and

(4) Incorporating density reduction factors and structural loss adjustments

(A) For projects located in California, Oregon, Washington, and Alaska: apply density conversion factors based on decay class from Harmon et al. (2011); and

(B) For projects located outside of Alaska, California, Oregon, and Washington: use the steps in Domke et al. (2011)

(5) Calculate the carbon in above-ground standing dead trees in MT $CO_2e$/acre.

(h) Estimate the carbon in the below-ground portion of standing live and dead trees by applying plot-level allometric equations provided on the Forest Offset Protocol Resources section of ARB's website.

[6] Biomass equations for the Alaska region directly estimate biomass and carbon and do not require tree volume to be computed prior to converting to biomass and carbon mass estimates.

(1) For projects located in California, Oregon, Washington, and Alaska: sum the above-ground standing live and above-ground standing dead tree carbon stocks and then apply the methodology described in Cairns, Brown, Helmer, & Baumgardner (1997) at the plot level to estimate below-ground biomass density based on above-ground biomass density in tons per hectare. Application of Cairns must be consistent for both baseline and project activity.

(2) For projects located outside of Alaska, California, Oregon, and Washington: apply the component ratio method to estimate below-ground biomass.

(3) Convert the carbon in below-ground standing live trees into MT $CO_2e$/acre.

(i) For carbon pools that are stratified, enter the information derived from the preceding steps into table A.2. Table A.2 requires the Offset Project Operator or Authorized Project Designee to identify the metric tons $CO_2e$ by stratum and identify the percentage of carbon each stratum represents in relation to the total project area. This table provides valuable information to the offset verifiers as they identify areas of risk when planning their site visit.

**Table A.2. Summarizing Total Carbon by Carbon Pool and Stratum**

**Carbon Pool:_____**

| Strata Name | No. of Plots | Carbon ($CO_2$/acre) | | | Acres | Carbon ($CO_2$) Total | Percentage Carbon ($CO_2$) Total |
|---|---|---|---|---|---|---|---|
| | | Avg | Std. Dev. | Std. Error | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **Total** | | | | | | | |

(j) The metric tons of $CO_2e$/acre in each carbon pool, as derived from the preceding steps, must be entered in table A.3.

**Table A.3. Summarizing Carbon Pools and Total MT CO2e/acre by Carbon Pool**

| Carbon Pool | Source | Gross MT $CO_2e$ per Acre |
|---|---|---|
| Standing Live Tree Above- and Below-ground Carbon Stocks | From sampling results of trees. | |

| | | |
|---|---|---|
| Standing Dead Tree Above- and Below-ground Carbon Stocks | From sampling results of standing dead biomass. | |
| Shrubs and Herbaceous Understory Carbon (if required) | From sampling results of shrubs and herbaceous understory. | |
| Soil Carbon (if required) | From sampling results of soil. | |
| Sum of MT $CO_2e$ from Required Pools | | |

(k) Determine a confidence deduction based on the sampling error for required onsite carbon pools derived from sampling. The sampling error is calculated for each of the sampled pools at the 90 percent confidence interval and subsequently calculated as a percentage of the mean, using the following steps:

(1) Calculate the standard error of the inventory estimate (based on the carbon in all carbon pools included in the forest carbon inventory;

(2) Multiply the standard error by 1.645;

(3) Divide the result in (2) by the total inventory estimate and multiply by 100. This establishes the sampling error (expressed as a percentage of the mean inventory estimate from field sampling) for a 90 percent confidence interval; and

(4) Consult table A.4 to determine the percent confidence deduction that must be applied to the inventory estimate of onsite carbon stocks for the purpose of calculating GHG emission reductions and removals (i.e., variable $CD_y$ in equation 5.1).

**Table A.4. Forest Carbon Inventory Confidence Deductions Based on Level of Confidence in the Estimate Derived from Field Sampling**

| Sampling Error (% of Inventory Estimate) | Confidence Deduction |
|---|---|
| 0 to 5.0% | 0% |
| 5.1 to 19.9% | (Sampling Error – 5.0%) to the nearest $1/10^{th}$ percentage |
| 20% or greater | 100% |

(l) The confidence deduction must be applied each year to the inventory of actual onsite carbon stocks. A confidence deduction is *not* applied to baseline carbon stocks.

(m) The confidence deduction must be updated each time the offset project is subject to verification, but must remain unchanged between verifications.

(n) If increased sampling over time results in a lower confidence deduction at the time of verification, the lower deduction must be applied to inventory estimates in the most recent reporting period subject to verification at that time. ARB or registry offset credits may be issued in the most recent reporting period for any verified increase in quantified GHG emission reductions and GHG removal enhancements associated with the new (lower) confidence deduction.

(o) If a loss of qualified sampling plots results in a higher confidence deduction, this higher deduction is applied to the inventory estimates in the most recent reporting period subject to verification at that time. Any resulting decrease in quantified GHG emission reductions and GHG removal enhancements from prior years as a result of the increased confidence deduction will be treated as an intentional reversal, and must be compensated pursuant to the Regulation.

## Appendix B. Modeling Carbon Stocks – Quantification Methodology

This protocol requires the use of approved empirical-based models to estimate the baseline carbon stocks and project stocks of selected carbon pools within the project area. Field measurements provide the basis for inferring value through the use of these models.

(a) The following growth models have been approved for use (versions publicly available prior to January 1, 2015):
  (1) CACTOS: California Conifer Timber Output Simulator;
  (2) CRYPTOS Emulator;
  (3) FVS: Forest Vegetation Simulator;
  (4) SPS: Stand Projection System;
  (5) FPS: Forest Projection System; and
  (6) FORSEE: FORest and Stand Evaluation Environment.

(b) Under this protocol, these models are used to:
  (1) Estimate a forest project's baseline carbon stocks; and
  (2) Forecast actual carbon stocks expected under the forest project to determine expected harvesting volumes or updating forest carbon inventories. The limit to the use of models for updating plot data is described in appendix A.

(c) Inventory data from appendix A must be incorporated into the simulation models to project carbon stocks over time.

(d) Baseline carbon stocks must be projected forward from the date of the forest project's offset project commencement.

(e) Inventory plot data may be updated by simulating the diameter and height increment of sampled trees for the length of time between their sampled date and the reporting year. To qualify for this method:
  (1) The project area must be stratified into even-age management and uneven-age management;
  (2) Diameter increment must be based on the average annual increment of a minimum of 20 samples of radial growth for diameter increment for each 8" DBH (diameter at breast height) class, beginning at 0 – 8" DBH for each

management (even-age or uneven-age) type. The average annual increment must be added for each year according to the plot's sample date; and

(3) Height increment must be based on regression curves for each management type (even-age or uneven-age) developed from height measurements from the same trees from which the diameter increment data was obtained. The estimated height must be determined using the regression estimators for the 'grown' diameters as described above.

(f) If a model has the ability to convert biomass to carbon, it must include all the carbon pools required by this protocol.

(g) For all versions of ARB-approved models, the formulas, equations, and data embedded within each model must be transparent, such that the reported emissions reductions/removal enhancements are readily and easily traceable and verifiable by the offset verification team.

(h) The Offset Project Operators or Authorized Project Designee is responsible for developing a modeling plan that addresses all required forecasting or updating of baseline and actual carbon stocks for the forest project. The modeling plan must be approved during verification and must include:

(1) A description of all silviculture methods modeled. The description of each silviculture method will include:

(A) A description of the trees retained (by species groups if appropriate) at harvest;

(B) The harvest frequency (years between harvests); and

(C) Regeneration assumptions;

(2) A matrix documenting any and all legal constraints that affect forest management activities in the project area. The matrix must include:

(A) A description of each constraint;

(B) The geographic location for each constraint and the local, state, or federal agency associated with each constraint;

(C) A narrative that describes the effect of the constraint on forest management, including disclosure of assumptions used for canopy retention and/or habitat conditions and identification of any required

temporal conditions (e.g., 10% of inventory maintained as spotted owl habitat by 2030); and

(D) *A description of the silviculture methods that will be modeled to ensure the constraint is respected;

(3) A description of the site indexes used for each species and an explanation of the source of the site index values used; and

(4) A description of the model used and an explanation of how the model was calibrated for local use, if applicable.

(i) Modeling outputs must include:

(1) Periodic harvest, inventory, and growth estimates for the entire project area presented as total carbon tons and carbon tons per acre; and

(2) Harvest yield streams on modeled stands, averaged by silviculture method and constraints, which must include the period over which the harvest occurred and the estimated volume of wood removed.

(j) Projected baseline and actual carbon stocks must be portrayed in a graph depicting time (starting from offset project commencement) in the x-axis and carbon tons in the y-axis. A reference point depicting the initial above-ground standing live tree carbon stocks must be included in the graph. The graph must be supported with written characterizations that explain any annual changes in baseline carbon stocks over time. These characterizations must be consistent with the baseline analysis required in chapter 5.

## Appendix C. Estimating Carbon in Wood Products – Quantification Methodology

The carbon stored in wood products over 100 years is included within the offset project boundary of all forest offset projects. Offset Project Operators or Authorized Project Designees must use this appendix to quantify the amount of carbon in harvested wood products for both the baseline and project scenarios.

(a) Determine the baseline amount of carbon in standing live trees that would have been harvested during the reporting period and stored in wood products over 100 years ($BC_{wp,y}$ to be used in equation 5.1) by doing the following:

(1) Derive the amount of carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period.

(A) If the growth and harvesting model used to develop the baseline for onsite carbon stocks in chapter 5 provides metric tons carbon in the bole, without bark, for each species that would have been harvested, equations C.1 and C.2 may be skipped and that output data may be used for the amount of carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period ($BC_{dm,i,y}$) in equation C.3; and

(B) If the growth and harvesting model used to develop the baseline for onsite carbon stocks in chapter 5 does not provide metric tons carbon in the bole, without bark, for each species that would have been harvested, determine the amount of carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period ($BC_{dm,i,y}$) using equation C.1 if based on harvest volume ($ft^3$) or equation C.2 if based green weight (lb.).

**Equation C.1. Baseline Carbon Delivered to Mill Using Wood Volume**

$$BC_{dm,i,y} = \frac{HW_{vol,i,y} \; x \; WDF_i \; x \; 0.5}{2{,}204.6}$$

*Where,*

| | | |
|---|---|---|
| $BC_{dm,i,y}$ | = | Baseline carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species that would have been harvested in reporting period |

| | | |
|---|---|---|
| *y* | = | Reporting period |
| $HW_{vol,i,y}$ | = | Volume of wood, of species i, that would have been harvested during the reporting period according to baseline model ($ft^3$) |
| $WDF_i$ | = | Wood density factor for species i. Obtain wood density factor from Smith et al. if project is located in the Pacific Northwest and from the USFS Wood Handbook if project is located in other regions. |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

**Equation C.2. Baseline Carbon Delivered to Mill Using Green Weight of Wood**

$$BC_{dm,i,y} = \frac{(HW_{gw,i,y} - WW_i)\ x\ 0.5}{2{,}204.6}$$

*Where,*

| | | |
|---|---|---|
| $BC_{dm,i,y}$ | = | Baseline carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species that would have been harvested in reporting period |
| *y* | = | Reporting period |
| $HW_{gw,i,y}$ | = | Green weight of wood, of species i, harvested during the reporting period according to baseline model (lb.) |
| $WW_i$ | = | Water weight of wood based on moisture content of the wood, of species i, harvested during the reporting period (lb.) |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

(2) Determine the total amount of carbon in harvested standing live trees delivered to mills that would have been transferred into wood products during the reporting period ($CTWP_{i,y}$) using equation C.3. If wood product classes cannot be assessed at the species level, carbon weight may be aggregated across species.

**Equation C.3. Baseline Carbon Transferred to Wood Products**

$CTWP_{i,y} = BC_{dm,i,y} \times ME_i$

*Where,*

| | | |
|---|---|---|
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees that would have been transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species that would have been harvested in reporting period |
| *y* | = | Reporting period |
| $BC_{dm,i,y}$ | = | Baseline carbon in standing live trees that would have been harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| $ME_i$ | = | Mill efficiency for species i; use the actual efficiency from the mill, if available, or the mill efficiency identified for the project's mill location(s) obtained from the Regional Mill Efficiency Database found on the Forest Offset Protocol Resources section of ARB's website; if the mill efficiency is not available at the |

| | | |
|---|---|---|
| | | species level, an aggregate mill efficiency may be used (%) |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

(3) Determine the average amount of carbon transferred to wood products that would have remained stored in in-use wood products over 100 years ($WP_{in\text{-}use,y}$) by completing the following steps:

(A) Determine the percentage of a harvest that would end up in each wood product class during the reporting period, determined separately for each species if data is broken down by species ($PC_{i,y}$), by:

1. Obtaining a verified report from the mill(s) where the project area's logs are sold indicating the product class categories the mill(s) sold that year;
2. If a verified report cannot be obtained, looking up default wood product classes for the project's assessment area, as given in the Assessment Area Data File associated with this protocol version available in the Forest Offset Protocol Resources section of ARB's website; or
3. If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous;"

(B) Enter the percentages into row 1 of table C.1 ($PC_{i,y}$). Complete a separate table for each species that would have been harvested during the reporting period;

(C) Determine the amount of carbon that would have been transferred to each product class, determined separately for each species if wood product classes are broken down by species ($CTPC_{i,y}$), using equation C.4;

**Equation C.4. Baseline Carbon Transferred to In-Use Wood Products by Product Class**

$CTPC_{i,y} = CTWP_{i,y} \times PC_{i,y}$

*Where,*

| | | |
|---|---|---|
| $CTPC_{i,y}$ | = | Carbon transferred to each product class; calculated separately for each species if wood product classes are broken down by species (MT C) |
| $i$ | = | Species that would have been harvested in reporting period |
| $y$ | = | Reporting period |
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees that would have been transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| $PC_{i,y}$ | = | Percentage of harvest that would have ended up in each product class during the reporting period; determined separately for each species if data is broken down by species (%) |

(D) Enter the amount of carbon that would have been transferred to each product class ($CTPC_{i,y}$) into row 2 of table C.1. Complete a separate table for each species that would have been harvested during the reporting period;

**Table C.1. Worksheet to Estimate Baseline Long-Term Carbon Storage in In-Use Wood Products**

| Rows | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| | Wood Product Class | Softwood Lumber | Hardwood lumber | Softwood Plywood | Oriented Strandboard | Non Structural Panels | Miscellaneous Products | Paper | Alaskan Exports |
| 1 | % in each class | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) |
| 2 | Metric tons C in each class | (2A) | (2B) | (2C) | (2D) | (2E) | (2F) | (2G) | (2H) |
| 3 | 100-year average storage factor (in-use) | 0.463 | 0.250 | 0.484 | 0.582 | 0.380 | 0.176 | 0.058 | 0.391 |
| 4 | Average C stored in in-use wood products (metric tons) | (4A) | (4B) | (4C) | (4D) | (4E) | (4F) | (4G) | (4H) |

(E) Multiply the values in 2A through 2H by the 100 year average storage factor provided in 3A through 3H and enter the resulting values in row 4 of table C.1; and

(F) Calculate the average carbon, in terms of $CO_2e$, that would have been stored in in-use wood products over 100 years ($WP_{in\text{-}use,y}$) using equation C.5.

**Equation C.5. Average Baseline Carbon Stored in In-Use Wood Products Over 100 Years**

$WP_{in\text{-}use,y} = \sum(Row\ 4) \times 3.667$

*Where,*

| | | |
|---|---|---|
| $WP_{in\text{-}use,y}$ | = | Average carbon that would have been stored in in-use wood products over 100 years during the reporting period (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.1 (MT C) |
| *3.667* | = | Carbon to carbon dioxide conversion factor |

(4) Determine the average amount of carbon transferred to wood products that would have remained stored in wood products in landfills over 100 years ($WP_{landfill,y}$) by completing the following steps:

(A) Determine the percentage of a harvest that would end up in each wood product class during the reporting period, determined separately for each species if data is broken down by species ($PC_{i,y}$), by:

1. Obtaining a verified report from the mill(s) where the project area's logs are sold indicating the product class categories the mill(s) sold that year;
2. If a verified report cannot be obtained, looking up default wood product classes for the project's assessment area, as given in the Assessment Area Data File associated with this protocol version available in the Forest Offset Protocol Resources section of ARB's website; or
3. If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous;"

(B) Enter the percentages into row 1 of table C.2 ($PC_{i,y}$). Complete a separate table for each species that would have been harvested during the reporting period;

(C) Determine the amount of carbon transferred to each product class, determined separately for each species if wood product classes are broken down by species ($CTPC_{i,y}$), using equation C.6;

**Equation C.6. Baseline Carbon Transferred to Wood Products in Landfills by Product Class**

$CTPC_{i,y} = CTWP_{i,y} \times PC_{i,y}$

*Where,*

| | | |
|---|---|---|
| $CTPC_{i,y}$ | = | Carbon transferred to each product class; calculated separately for each species if wood product classes are broken down by species (MT C) |
| $i$ | = | Species that would have been harvested in reporting period |
| $y$ | = | Reporting period |
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees that would have been transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| $PC_{i,y}$ | = | Percentage of harvest that would have ended up in each product class during the reporting period; determined separately for each species if data is broken down by species (%) |

(D) Enter the amount of carbon that would have been transferred to each product class ($CTPC_{i,y}$) into row 2 of table C.2. Complete a separate table for each species that would have been harvested during the reporting period;

**Table C.2. Worksheet to Estimate Baseline Long-Term Carbon Storage in Wood Products in Landfills**

| Rows | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| | Wood Product Class | Softwood Lumber | Hardwood lumber | Softwood Plywood | Oriented Strandboard | Non Structural Panels | Miscellaneous Products | Paper | Alaskan Exports |
| 1 | % in each class | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) |
| 2 | Metric tons C in each class | (2A) | (2B) | (2C) | (2D) | (2E) | (2F) | (2G) | (2H) |
| 3 | 100-year average storage factor | 0.298 | 0.414 | 0.287 | 0.233 | 0.344 | 0.454 | 0.178 | 0.284 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (landfills) | | | | | | | | |
| 4 | Average C stored in landfills (metric tons) | (4A) | (4B) | (4C) | (4D) | (4E) | (4F) | (4G) | (4H) |

(E) Multiply the values in 2A through 2H by the 100 year average storage factor provided in 3A through 3H and enter the resulting values in row 4 of table C.2; and

(F) Calculate the average carbon, in terms of $CO_2e$, that would have been stored in wood products in landfills over 100 years ($WP_{landfill,y}$) using equation C.7.

**Equation C.7. Average Baseline Carbon Stored in Wood Products in Landfills Over 100 Years**

$WP_{landfill,y} = \sum(Row\ 4) \times 3.667$

*Where,*

| | | |
|---|---|---|
| $WP_{landfill,y}$ | = | Average carbon that would have been stored in wood products in landfills over 100 years during the reporting period (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.2 (MT C) |
| *3.667* | = | Carbon to carbon dioxide conversion factor |

(5) Determine the appropriate value to use for the average carbon that would have been stored in wood products in landfills over 100 years ($WP_{landfill,y}$) based on the following and using equation C.8:

(A) Landfill carbon storage is *excluded* from calculations of wood-product carbon in years when actual harvesting volumes of standing live and standing dead trees exceed estimated baseline harvesting volumes, assessed cumulatively since project start; and

(B) Landfill carbon storage is *included* in calculations of wood-product carbon in years when actual harvesting volumes are below estimated baseline harvesting volumes, assessed cumulatively since project start.

**Equation C.8. Average Baseline Carbon Stored in Wood Products in Landfills Over 100 Years for Use in Equation C.9**

$$If \sum_{n=1}^{y} (AC_{hv,n} - BC_{hv,n}) < 0, then\ WP_{landfill,y} = \sum (Row4) \times 3.667$$

$$If \sum_{n=1}^{y} (AC_{hv,n} - BC_{hv}) > 0, then\ WP_{landfill,y} = 0$$

*Where,*

| | | |
|---|---|---|
| $WP_{landfill,y}$ | = | Average carbon that would have been stored in wood products in landfills over 100 years from wood harvested during the reporting period |
| $AC_{hv\ n}$ | = | Actual amount of carbon in standing live and standing dead trees (whole bole only, no bark) harvested in reporting period n (MT $CO_2e$) |
| $BC_{hv,n}$ | = | Estimated average amount of carbon in standing live and standing dead trees (bole only, no bark) that would have been harvested in reporting period n (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.2; sum values for all species (MT C) |

(6) Determine the average annual baseline carbon in wood products that would have remained stored for at least 100 years ($BC_{wp,y}$ to be used in equation 5.1) using equation C.9.

**Equation C.9. Total Average Baseline Carbon Stored in Wood Products**

$$BC_{wp,\,y} = \sum_i WP_{in-use,y} + \sum_i WP_{landfill,y}$$

*Where,*

| | | |
|---|---|---|
| $BC_{wp,y}$ | = | Average carbon stored over 100 years from wood that would have been harvested during the reporting period (MT $CO_2e$) |
| $WP_{in\text{-}use,y}$ | = | Average carbon stored in in-use wood products over 100 years from wood that would have been harvested during the reporting period (MT $CO_2e$) |
| $WP_{landfill\ y}$ | = | Average carbon stored in wood products in landfills over 100 years from wood that would have been harvested during the reporting period (MT $CO_2e$) |
| *i* | = | Species that would have been harvested in reporting period |
| *y* | = | Reporting period |

(b) Determine the actual amount of carbon in standing live trees harvested during the reporting period and stored in wood products over 100 years ($AC_{wp,y}$ to be used in equation 5.1) by doing the following:

(1) Determine the amount of carbon in standing live trees harvested and delivered to a mill during the reporting period ($AC_{dm,i,y}$) using equation C.10 if based on harvest volume ($ft^3$) or equation C.11 if based green weight (lb.);

**Equation C.10. Actual Carbon Delivered to Mill Using Wood Volume**

$$AC_{dm,i,y} = \frac{HW_{vol,i,y} \; x \; WDF_i \; x \; 0.5}{2{,}204.6}$$

*Where,*

| | | |
|---|---|---|
| $AC_{dm,i,y}$ | = | Actual carbon in standing live trees harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species harvested in reporting period |
| *y* | = | Reporting period |
| $HW_{vol,i,y}$ | = | Volume of wood, of species i, harvested during the reporting period ($ft^3$) |
| $WDF_i$ | = | Wood density factor for species i. Obtain wood density factor from Smith et al. if project is located in the Pacific Northwest and from the USFS Wood Handbook if project is located in other regions. |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

**Equation C.11. Actual Carbon Delivered to Mill Using Green Weight of Wood**

$$AC_{dm,i,y} = \frac{(HW_{gw,i,y} - WW_i) \; x \; 0.5}{2{,}204.6}$$

*Where,*

| | | |
|---|---|---|
| $AC_{dm,i,y}$ | = | Actual carbon in standing live trees harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species harvested in reporting period |
| *y* | = | Reporting period |
| $HW_{gw,i,y}$ | = | Green weight of wood, of species i, harvested during the reporting period (lb.) |
| $WW_i$ | = | Water weight of wood based on moisture content of the wood, of species i, harvested during the reporting period (lb.) |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

(2) Determine the total amount of carbon in harvested standing live trees delivered to mills transferred into wood products during the reporting period ($CTWP_{i,y}$) using equation C.12;

**Equation C.12. Actual Carbon Transferred to Wood Products**

$$CTWP_{i,y} = AC_{dm,i,y} \; x \; ME_i$$

*Where,*

| | | |
|---|---|---|
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| *i* | = | Species harvested in reporting period |
| *y* | = | Reporting period |
| $AC_{dm,i,y}$ | = | Actual carbon in standing live trees harvested and delivered to a mill during the reporting period; calculated separately for each species (MT C) |
| $ME_i$ | = | Mill efficiency for species i; use the actual efficiency from the mill, if available, or the mill efficiency identified for the project's mill location(s) obtained from the Regional Mill Efficiency Database found on the Forest Offset Protocol Resources section of ARB's website; if the mill efficiency is not available at the species level, an aggregate mill efficiency may be used (%) |
| *0.5* | = | lbs. C/lb. wood |
| *2,204.6* | = | lbs. C/MT C |

(3) Determine the average amount of carbon transferred to wood products that will remain stored in in-use wood products over 100 years ($WP_{in\text{-}use,y}$) by completing the following steps:

(A) Determine the percentage of a harvest that ends up in each wood product class during the reporting period, determined separately for each species if data is broken down by species ($PC_{i,y}$), by:

1. Obtaining a verified report from the mill(s) where the project area's logs are sold indicating the product class categories the mill(s) sold that year;
2. If a verified report cannot be obtained, looking up default wood product classes for the project's assessment area, as given in the Assessment Area Data File associated with this protocol version available in the Forest Offset Protocol Resources section of ARB's website; or
3. If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous;"

(B) Enter the percentages into row 1 of table C.3 ($PC_{i,y}$). Complete a separate table for each species harvested during the reporting period;

(C) Determine the amount of carbon transferred to each product class, determined separately for each species if wood product classes are broken down by species ($CTPC_{i,y}$), using equation C.13;

**Equation C.13. Actual Carbon Transferred to In-Use Wood Products by Product Class**

$CTPC_{i,y} = CTWP_{i,y} \times PC_{i,y}$

*Where,*

| | | |
|---|---|---|
| $CTPC_{i,y}$ | = | Carbon transferred to each product class; calculated separately for each species if wood product classes are broken down by species (MT C) |
| $i$ | = | Species harvested during the reporting period |
| $y$ | = | Reporting period |
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| $PC_{i,y}$ | = | Percentage of harvest that ends up in each product class during the reporting period; determined separately for each species if data is broken down by species (%) |

(D) Enter the amount of carbon transferred to each product class ($CTPC_{i,y}$) into row 2 of table C.3. Complete a separate table for each species harvested during the reporting period;

**Table C.3. Worksheet to Estimate Actual Long-Term Carbon Storage in In-Use Wood Products**

| Rows | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| | Wood Product Class | Softwood Lumber | Hardwood lumber | Softwood Plywood | Oriented Strandboard | Non Structural Panels | Miscellaneous Products | Paper | Alaskan Exports |
| 1 | % in each class | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) |
| 2 | Metric tons C in each class | (2A) | (2B) | (2C) | (2D) | (2E) | (2F) | (2G) | (2H) |
| 3 | 100-year average storage factor (in-use) | 0.463 | 0.250 | 0.484 | 0.582 | 0.380 | 0.176 | 0.058 | 0.391 |
| 4 | Average C stored in in-use wood products (metric tons) | (4A) | (4B) | (4C) | (4D) | (4E) | (4F) | (4G) | (4H) |

(E) Multiply the values in 2A through 2H by the 100 year average storage factor provided in 3A through 3H and enter the resulting values in row 4 of table C.3; and

(F) Calculate the average carbon, in terms of $CO_2e$, stored in in-use wood products over 100 years ($WP_{in\text{-}use,y}$) using equation C.14.

**Equation C.14. Average Actual Carbon Stored in In-Use Wood Products Over 100 Years**

$WP_{in\text{-}use,y} = \sum(Row\ 4) \times 3.667$

*Where,*

| | | |
|---|---|---|
| $WP_{in\text{-}use,y}$ | = | Average carbon stored in in-use wood products over 100 years during the reporting period (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.3 (MT C) |
| *3.667* | = | Carbon to carbon dioxide conversion factor |

(4) Determine the average amount of carbon transferred to wood products that will remain stored in wood products in landfills over 100 years ($WP_{landfill,y}$) by completing the following steps:

(A) Determine the percentage of a harvest that ends up in each wood product class during the reporting period, determined separately for each species if data is broken down by species ($PC_{i,y}$), by:

1. Obtaining a verified report from the mill(s) where the project area's logs are sold indicating the product class categories the mill(s) sold that year;
2. If a verified report cannot be obtained, looking up default wood product classes for the project's assessment area, as given in the Assessment Area Data File associated with this protocol version available in the Forest Offset Protocol Resources section of ARB's website; or
3. If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous;"

(B) Enter the percentages into row 1 of table C.4 ($PC_{i,y}$). Complete a separate table for each species harvested during the reporting period;

(C) Determine the amount of carbon transferred to each product class, determined separately for each species if wood product classes are broken down by species ($CTPC_{i,y}$), using equation C.15;

**Equation C.15. Actual Carbon Transferred to Wood Products in Landfills by Product Class**

$CTPC_{i,y} = CTWP_{i,y} \times PC_{i,y}$

*Where,*

| | | |
|---|---|---|
| $CTPC_{i,y}$ | = | Carbon transferred to each product class; calculated separately for each species if wood product classes are broken down by species (MT C) |
| $i$ | = | Species harvested during the reporting period |
| $y$ | = | Reporting period |
| $CTWP_{i,y}$ | = | Carbon in harvested standing live trees transferred to wood products during the reporting period; calculated separately for each species (MT C) |
| $PC_{i,y}$ | = | Percentage of harvest that ends up in each product class during the reporting period; determined separately for each species if data is broken down by species (%) |

(D) Enter the amount of carbon transferred to each product class ($CTPC_{i,y}$) into row 2 of table C.4. Complete a separate table for each species harvested during the reporting period;

**Table C.4. Worksheet to Estimate Actual Long-Term Carbon Storage in Wood Products in Landfills**

| Rows | | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|---|
| | Wood Product Class | Softwood Lumber | Hardwood lumber | Softwood Plywood | Oriented Strandboard | Non Structural Panels | Miscellaneous Products | Paper | Alaskan Exports |
| 1 | % in each class | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) | (X%) |
| 2 | Metric tons C in each class | (2A) | (2B) | (2C) | (2D) | (2E) | (2F) | (2G) | (2H) |
| 3 | 100-year average storage factor (landfills) | 0.298 | 0.414 | 0.287 | 0.233 | 0.344 | 0.454 | 0.178 | 0.284 |
| 4 | Average C stored in landfills (metric tons) | (4A) | (4B) | (4C) | (4D) | (4E) | (4F) | (4G) | (4H) |

(E) Multiply the values in 2A through 2H by the 100 year average storage factor provided in 3A through 3H and enter the resulting values in row 4 of table C.4; and

(F) Calculate the average carbon, in terms of $CO_2e$, stored in wood products in landfills over 100 years ($WP_{landfill,y}$) using equation C.16.

**Equation C.16. Average Actual Carbon Stored in Wood Products in Landfills Over 100 Years**

$WP_{landfill,y} = \sum(Row\ 4) \times 3.667$

*Where,*

| | | |
|---|---|---|
| $WP_{landfill,y}$ | = | Average carbon stored in wood products in landfills over 100 years during the reporting period (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.4 (MT C) |
| *3.667* | = | Carbon to carbon dioxide conversion factor |

(5) Determine the appropriate value to use for the average carbon stored in wood products in landfills over 100 years ($WP_{landfill,y}$) based on the following and using equation C.17:

(A) Landfill carbon storage is *excluded* from calculations of wood-product carbon in years when actual harvesting volumes of standing live and standing dead trees exceed estimated baseline harvesting volumes, assessed cumulatively since project start; and

(B) Landfill carbon storage is *included* in calculations of wood-product carbon in years when actual harvesting volumes of standing live and standing dead trees are below estimated baseline harvesting volumes, assessed cumulatively since project start; and

**Equation C.17. Average Actual Carbon Stored in Wood Products in Landfills Over 100 Years for Use in Equation C.18**

$$If \sum_{n=1}^{y} \left(AC_{hv,n} - BC_{hv,n}\right) < 0, then\ WP_{landfill,y} = \sum (Row4) \times 3.667$$

$$If \sum_{n=1}^{y} \left(AC_{hv,n} - BC_{hv,n}\right) > 0, then\ WP_{landfill,y} = 0$$

*Where,*

| | | |
|---|---|---|
| $WP_{landfill,y}$ | = | Average carbon stored in wood products in landfills over 100 years from wood harvested during the reporting period |
| $AC_{hv\ n}$ | = | Actual amount of carbon in standing live trees (bole only) harvested in reporting period n (MT $CO_2e$) |

| | | |
|---|---|---|
| $BC_{hv,n}$ | = | Estimated average amount of carbon in standing live and standing dead trees (bole only) that would have been harvested in reporting period n (MT $CO_2e$) |
| *y* | = | Reporting period |
| *Row 4* | = | Values contained within row 4 of table C.4; sum values for all species (MT C) |

(6) Determine the actual carbon in wood products produced during the reporting period that is projected to remain stored for at least 100 years ($AC_{wp,y}$ to be used in equation 5.1) using equation C.18.

**Equation C.18. Total Carbon Stored in Wood Products**

$$AC_{wp,\,y} = \sum_i WP_{in-use,y} + \sum_i WP_{landfill,y}$$

*Where,*

| | | |
|---|---|---|
| $AC_{wp,y}$ | = | Actual carbon in wood products produced during the reporting period that is projected to remain stored for at least 100 years (MT $CO_2e$) |
| $WP_{in\text{-}use,y}$ | = | Average carbon stored in in-use wood products over 100 years from wood harvested during the reporting period (MT $CO_2e$) |
| $WP_{landfill\ y}$ | = | Average carbon stored in wood products in landfills over 100 years from wood harvested during the reporting period (MT $CO_2e$) |
| *i* | = | Species harvested in reporting period |
| *y* | = | Reporting period |

## Appendix D. Determination of a Forest Project's Reversal Risk Rating

ARB maintains a Forest Buffer Account to insure against unintentional reversals. ARB offset credits will be contributed to the Forest Buffer Account pursuant to the Regulation. The quantity of the contribution is determined by a project's reversal risk rating based on the potential for reversals associated with different types of risks and project-specific circumstances.

(a) The Offset Project Operator or Authorized Project Designee is required to determine the project's reversal risk rating prior to listing, and recalculate it every time the forest project undergoes verification.

(b) If estimated risk values and associated mitigation measures are updated as improvements in quantifying risks or changes in risks are determined, any adjustments to the reversal risk ratings will affect only current and future year contributions to the Forest Buffer Account.

(c) For a Qualified Conservation Easement to be considered for a reporting period it must be in place prior to the end of the reporting period.

(d) Risks that may lead to reversals are classified into the categories identified in table D.1.

**Table D.1. Forest Project Risk Types**

| Risk Category | Risk Type | Description |
|---|---|---|
| Financial | Financial Failure Leading to Bankruptcy | Financial failure can lead to bankruptcy and/or alternative management decisions to generate income that result in reversals through over-harvesting or conversion |
| Management | Illegal Harvesting | Loss of project stocks due to timber theft |
| | Conversion to Non-Forest Uses | Alternative land uses are exercised at project carbon expense |
| | Over-Harvesting | Exercising timber value at expense of project carbon |
| Social | Social Risks | Changing government policies, regulations, and general economic conditions |
| Natural Disturbance | Wildfire | Loss of project carbon through wildfire |
| | Disease/Insects | Loss of project carbon through disease and/or insects |
| | Other Episodic Catastrophic Events | Loss of project carbon from wind, snow and ice, or flooding events |

(e) The project reversal risk rating must be determined using the tables in this appendix which are designed to identify and quantify the specific types of risks that may lead to a reversal, based on project-specific factors. The Offset Project Operator or Authorized Project Designee must determine the contribution to the reversal risk rating for each risk type below.

(1) Financial Risk: Financial failure of an organization resulting in bankruptcy can lead to dissolution of agreements and forest management activities to recover losses that result in reversals. Forest projects that employ a qualified conservation easement or that occur on public or tribal lands have lower risk.

**Table D.2. Financial Risk**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project with a qualified conservation easement | 1% |
| Forest project on public or tribal lands | 1% |
| Forest project without a qualified conservation easement and not on public or tribal lands | 5% |

(2) Management Risk: Management failure is the risk of management activities that directly or indirectly could lead to a reversal

(A) Management Risk I – Illegal Removals of Forest Biomass: Illegal logging occurs when biomass is removed either by trespass or outside of a planned set of management activities that are controlled by regulation. Illegal logging is exacerbated by lack of controls and enforcement activities.

**Table D.3. Risk of Illegal Removals of Forest Biomass**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project within the United States | 0% |

(B) Management Risk II – Conversion of Project Area to Alternative Land Uses: High values for development of housing and/or agriculture may compete with timber and carbon values and lead to a change in land use that affects carbon stocks. The risk of conversion of any project area to

other non-forest uses is related to the probability of alternative uses, which are affected by many variables, including population growth, topography, proximity to provisions and metropolitan areas, availability of water and power, and quality of access to the project area.

**Table D.4. Risk of Conversion to Alternative Land Use**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project with a qualified conservation easement that explicitly encumbers all development rights | 0% |
| Forest project on public or tribal lands | 0% |
| Forest project without a qualified conservation easement that explicitly encumbers all development rights and not on public or tribal lands | 2% |

(C) Management Risk III – Over-Harvesting: Favorable timber values, among other reasons, may motivate an Offset Project Operator or Authorized Project Designee to realize timber values at the expense of managing carbon stocks for which ARB or registry offset credits have been issued. Additionally, reversals can occur as the result of harvest associated with fuels treatments.

**Table D.5. Risk of Over-Harvesting**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project with a qualified conservation easement that explicitly encumbers all timber harvesting associated with project stocks | 0% |
| Forest project on public or tribal lands | 0% |
| Forest project without a qualified conservation easement that explicitly encumbers all timber harvesting associated with project stocks and not on public or tribal lands | 2% |

(3) Social Risk: Social risks exist due to changing government policies, regulations, and general economic conditions. The risks of social or political actions leading to reversals are low, but could be significant.

**Table D.6. Social Risk**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project within the United States | 0% |

(4) Natural Disturbance Risk: Natural disturbances can pose a significant risk to the permanence of the GHG emission reductions and GHG removal enhancements. Natural disturbance risks are only partially controllable by management activities. Management activities that improve resiliency to wildfire, insects, and disease can reduce these risks. Management activities that shift harvesting practices from live sequestering trees to trees that have succumbed to natural disturbances reduce or negate the reversal depending on the size and location of the disturbance.

(A) Natural Disturbance Risk I – Wildfire: A wildfire has the potential to cause significant reversals, especially in certain carbon pools. These risks can be reduced by certain techniques including reducing surface fuel loads, removing ladder fuels, adding fuel breaks, and reducing stand density. However, these techniques cannot reduce emission risk to zero because all landowners will not undertake fuel treatments, nor can they prevent wildfire from occurring.

**Table D.7. Natural Disturbance Risk I – Wildfire**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project that has conducted fire risk reduction work on the project area that contributed to lowering the fire risk for the entire project area as confirmed in the form of written communication from either the local or state fire protection agency who has direct responsibility for fire protection over the project area. The methodology for how the project-specific assessment is being applied must be submitted as part of the OPDR. | 2% |
| Forest project that has not conducted fire risk reduction work on the project area | 4% |

(B) Natural Disturbance Risk II - Disease or Insect Outbreak: A disease or insect outbreak has the potential to cause a reversal, especially in certain carbon pools.

**Table D.8. Natural Disturbance Risk II – Disease or Insect Outbreak**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project within the United States | 3% |

(C) Natural Disturbance Risk III - Other Episodic Catastrophic Events: A major wind-throw event (hurricane, tornado, high wind event) has the potential to cause a reversal, especially in certain carbon pools.

**Table D.9. Natural Disturbance Risk III – Other Episodic Catastrophic Events**

| Project Specific Circumstances | Contribution to Reversal Risk Rating |
|---|---|
| Forest project within the United States | 3% |

(f) Use table D.10 to summarize the forest project's reversal risk rating. As indicated above, projects that employ a qualified conservation easement, or that occur on public lands, are exempt from certain risk categories. Such qualified conservation easements must clearly identify the goals and objectives of the forest project according to the terms of this protocol.

**Table D.10. Project Contribution to the Buffer Account Based on Risk.**

| Risk Type | Risk Category | Contribution to Reversal Risk Rating From Tables D.2-D.9 |
|---|---|---|
| Financial | Financial Failure | |
| Management | Illegal Forest Biomass Removal | |
| | Conversion | |
| | Over-Harvesting | |
| Social | Social | |
| Natural Disturbance | Wildfire | |
| | Disease or Insect Outbreak | |
| | Other Catastrophic Events | |

(g) The forest project's reversal risk rating is calculated using equation D.1.

**Equation D.1. Reversal Risk Rating**

$$100\% - \left( \begin{array}{l} (100\% - FinancialFailure\%) \times (100\% - IllegalForestBiomassRemoval\%) \times (100\% - Conversion\%) \\ \times (100\% - OverHarvesting\%) \times (100\% - SocialRisk\%) \times (100\% - Wildfire\%) \times \\ (100\% - Disease/InsectOutbreak\%) \times (100\% - OtherCatastrophicEvents\%) \end{array} \right)$$

## Appendix E. Reforestation Project Eligibility

Reforestation projects on lands that have undergone a significant disturbance must assess their eligibility using the standardized approach presented in this appendix to determine whether reforestation activities are likely to be "business as usual" based on the net present value for the timber expected to be produced from reforestation.

(a) A reforestation project is considered "business as usual" if the net present value for expected timber is $0 or more.

(b) To determine whether a reforestation project is eligible, perform the following steps:

  (1) Identify whether site preparation costs are high or low:

    (A) Site preparation costs are high if:

      1. Competing species management (including mechanical removal and/or use of herbicides) has been or will be conducted on 50 percent or more of the project area; or

      2. Soil ripping has occurred or will occur on more than 50 percent of the project area.

    (B) Site preparation costs are low for all other projects.

  (2) Identify the value of harvested products (high, medium, low, or very low) corresponding to the project's assessment area from the Assessment Area Data File associated with this protocol version available from the Forest Offset Protocol Resources section of ARB's website.

  (3) Identify the standard rotation length for the project's assessment area, from the Assessment Area Data File associated with this protocol version available from the Forest Offset Protocol Resources section of ARB's website.

  (4) Identify the site class category for the project area. The category must be consistent with the stated site class provided at time of listing. Projects with mixed site classes must round to the nearest site class category based on a weighted average.

    (A) Site classes I and II are classified as 'higher'.

    (B) Site classes III, IV, and V are classified as 'lower'.

(5) Determine whether the forest project is eligible according to the identified site preparation costs, value of harvested products, rotation length, and site class, as indicated in table E.1.

**Table E.1. Determination of Reforestation Project Eligibility**

| Site Preparation Costs | Value of Harvested Products | Rotation Length | Site Class | Eligibility | Scenario # |
|---|---|---|---|---|---|
| High Site Preparation | High | Short, Medium, or Long | Higher | Not Eligible | 1 |
| | | | Lower | Not Eligible | 2 |
| | | Extremely Long | Higher | Eligible | 3 |
| | | | Lower | Eligible | 4 |
| | Medium | Short or Medium | Higher | Not Eligible | 5 |
| | | | Lower | Not Eligible | 6 |
| | | Long | Higher | Not Eligible | 7 |
| | | | Lower | Eligible | 8 |
| | | Extremely Long | Higher | Eligible | 9 |
| | | | Lower | Eligible | 10 |
| | Low | Short | Higher | Not Eligible | 11 |
| | | | Lower | Eligible | 12 |
| | | Medium, Long, or Extremely Long | Higher | Eligible | 13 |
| | | | Lower | Eligible | 14 |
| | Very Low | Short, Medium, Long, or Extremely Long | Higher | Eligible | 15 |
| | | | Lower | Eligible | 16 |
| Low Site Preparation | High | Short or Medium | Higher | Not Eligible | 17 |
| | | | Lower | Not Eligible | 18 |
| | | Long or Extremely Long | Higher | Not Eligible | 19 |
| | | | Lower | Eligible | 20 |
| | Medium | Short or Medium | Higher | Not Eligible | 21 |
| | | | Lower | Not Eligible | 22 |
| | | Long | Higher | Not Eligible | 23 |
| | | | Lower | Eligible | 24 |
| | | Extremely Long | Higher | Eligible | 25 |
| | | | Lower | Eligible | 26 |
| | Low | Short | Higher | Not Eligible | 27 |
| | | | Lower | Not Eligible | 28 |
| | | Medium | Higher | Not Eligible | 29 |
| | | | Lower | Eligible | 30 |
| | | Long or Extremely Long | Higher | Eligible | 31 |
| | | | Lower | Eligible | 32 |
| | Very Low | Medium, Long, or Extremely Long | Higher | Eligible | 33 |
| | | | Lower | Eligible | 34 |
| | | Short | Higher | Not Eligible | 35 |
| | | | Lower | Not Eligible | 36 |

## Appendix F. Determining a Value for Common Practice – Quantification Methodology

Improved forest management projects on private lands must determine the common practice value for the project area from FIA data, based on its geographic location and boundaries. Offset Project Operators or Authorized Project Designees for improved forest management projects must perform the following steps to determine the appropriate common practice value:

(a) Determine the geographic ecosection(s) or supersection(s) within which the project area is located by consulting the supersection maps available from the Forest Offset Protocol Resources section of ARB's website;

(b) Determine which assessment area(s) are included within the project area, reference the Assessment Area Data File associated with this protocol version available from the Forest Offset Protocol Resources section of ARB's website and compare the tree species in the project area to the species list associated with each assessment area in the project's ecosection(s) or supersection(s) identified in the previous step;

(c) Determine the acreage of the project area that falls within each assessment area contained in the ecosection(s) or supersection(s). Any contiguous area 20 acres or greater within the project area that consists of a separate vegetation community must be independently mapped;

(d) For assessment areas where data are disaggregated by high and low site classes in the Assessment Area Data File associated with this protocol version available from the Forest Offset Protocol Resources section of ARB's website, the Offset Project Operator or Authorized Project Designee must further stratify the project area and identify the acreage that falls within each site class;

    (1) A "high" site class means the average of site class productivity codes I-IV (growth of ≥85 cubic feet/acre/year).

    (2) A "low" site class means the average of site class productivity codes V-VII (growth of <85 cubic feet/acre/year).

(e) Determine the portion of the project area that is in each site class for each assessment area using soils data from a state or federal agency, direct site class data from a state or federal agency, attestation from a state forester, or through field analysis. The Offset Project Operator or Authorized Project Designee must demonstrate that it has identified and assigned site trees for each strata or forest type grouping based upon the methodology described in the FIA Database National Core Field Guide Version 6 (October 2012), Section 7 to determine high or low site class for its project area. Whatever method is used, documentation of the analysis must be provided to the verifier at the project's initial verification;

(f) If data for an assessment area are provided for both high and low site classes, and an Offset Project Operator or Authorized Project Designee is unable or unwilling to stratify the project area into site classes using an acceptable method described above, then the high site-class common practice statistic must be used for all acres within the assessment area;

(g) For each assessment area and site class stratum within the project area, identify the appropriate common practice statistic from the Assessment Area Data File associated with this protocol version available from the Forest Offset Protocol Resources section of ARB's website. The value displayed in the Assessment Area Data File associated with this protocol version indicates $CO_2e$ metric tons per acre in the above ground portion (bole, bark, top and branches) of live trees; and

(h) Determine a single common practice value for the entire project area by calculating the average of the common practice statistics for each assessment area and site class, weighted by the number of acres of each assessment area and site class within the project area.

## Appendix G. References

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# Grassland Project Protocol V2.0

Protocol Summary

CLIMATE ACTION RESERVE

## Project Definition

The prevention of emissions of GHGs to the atmosphere due to land conversion and crop cultivation through perpetual conservation of an eligible grassland project area. Grassland is defined as an area of land dominated by native or introduced grass species with little to no tree canopy. Eligible areas include privately owned or certain non-federal publicly owned land. A single project may include multiple legal parcels if the area is held under ownership by a single landowner and covered by a single easement. Individual grassland projects may be managed and verified together as part of a cooperative. Project activities may include grazing, organic fertilizer use, irrigation, and recreation, but may not include the use of synthetic fertilizers.

## Project Eligibility Requirements

**Location:** Conterminous United States and U.S. tribal lands. Must be located on land whose particular combination(s) of Major Land Resource Area (MLRA), soil texture, and prior land use history would result in emissions of belowground organic carbon in the baseline scenario, as determined by the default baseline emission factors.

**Start Date:** The date on which the project area is committed to the continued management and protection of grassland either by submitting a project to the Reserve, recording a conservation easement, or by transferring ownership to a public or private entity with a provision to maintain the grassland as such. All projects must be submitted no more than six months after the project start date.

**Crediting Period:** Maximum of fifty years. In the case of cooperatives, project crediting periods will be tied to each individual grassland project within the cooperative and their respective start dates. The crediting period may be concluded at any time at the Project Owner's discretion.

**Performance Standard Test:** Projects must meet a two-part performance standard test:

- Financial threshold: Rental rate for cropland must be at least 40% greater than the rental rate for pastureland in the project county. Discount for uncertainty is applied for counties where rental rate difference is not at least 100%. Annual rental rate table is published by the Reserve.
- Suitability threshold: Projects must demonstrate that a minimum percentage of the project area is made up of soils having a Land Capability Classification of I-IV. Project Owners have the option of using a default threshold based on the MLRA of the project, or a site-specific threshold based on local conditions.

**Legal Requirement Test:** No legal barriers to converting land to cropland and no legal requirements to keep grassland as such.

**Ecosystem Services Payment Stacking and Credit Stacking:** Payment stacking and credit stacking for ecosystem services are permissible under certain circumstances, subject to the Legal Requirement Test and requirements for concurrent legally binding agreements. The Project Owner must disclose any payments or participation in such programs.

**Permanence Requirement:** Carbon must be stored for at least 100 years after the issuance of CRTs. Unless ownership of the land is transferred to the federal government, a Qualified Conservation Easement (QCE) must be recorded to ensure permanence. A QCE prohibits the conversion of the project area from grassland to another land use, such as cropland. Additionally, the Project Owner must enter into a Project Implementation Agreement with the Reserve. Monitoring and reporting must continue for at least 100 years after the last issuance of credits. Avoidable reversals are mitigated by the Project Owner, while unavoidable reversals are insured against through a shared risk buffer pool.

**Regulatory Compliance:** Projects must be in compliance with all relevant federal, state, and local regulations.

**Monitoring, Reporting, and Verification Schedule:** Annual monitoring includes prior land use, grazing activities, fertilizer application, irrigation, and fires. Periodic monitoring of ecosystem health is also required. Project verification must occur at least every six years during a project's crediting period. Site visits are not required for successful verification, but projects shall make an extra contribution to the risk buffer pool until the project site is visited for the purposes of verification.

## Project Is Ineligible If:

- Located on land contained in strata with either no data for modeling, or with no baseline emission reductions from belowground organic carbon in the first 10-year emission factor period
- Located on lands designated as wetlands and/or owned by the federal government
- Documentation from at least the past ten years are unavailable to determine eligibility

*This is a summary of the protocol. Please read the full protocol for a complete description of project requirements.*

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