California Environmental Protection Agency

Air Resources Board

Proposed Regulation to Implement the California Cap-and-Trade Program

PART V

STAFF REPORT AND COMPLIANCE OFFSET PROTOCOL

U.S. FOREST PROJECTS

Release Date: October 28, 2010

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State of California

California Environmental Protection Agency
AIR RESOURCES BOARD
Office of Climate Change

STAFF REPORT: INITIAL STATEMENT OF REASONS PROPOSED REGULATION TO IMPLEMENT THE CALIFORNIA CAP-AND-TRADE PROGRAM

PART V

STAFF REPORT AND COMPLIANCE OFFSET PROTOCOL

U.S. FOREST PROJECTS

Public Hearing to Consider the Proposed Regulation to Implement the California Cap-and-Trade Program

Date of Release: October 28, 2010
Scheduled for Consideration: December 16, 2010

Location:

California Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

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Compliance Offset Protocol for
Forest Projects
Date: October 1, 2010

Staff Report

I. Introduction and Background on Compliance Offset Protocols

A. Staff Proposal

Staff is recommending the Board adopt four compliance offset protocols to support the proposed Cap-and-Trade program. They include a compliance offset protocol for Livestock Manure (digester) projects, Ozone Depleting Substances destruction projects, Urban Forest projects, and Forest projects. This part discusses the development of a Compliance Offset Protocol for Forest Projects (Forest Offset Protocol).

B. Rationale for Compliance Offset Protocols

The Air Resources Board's (ARB or Board) proposed cap-and-trade program allows the use of offsets, emission reductions from uncapped sectors, to comply with emission reduction obligations. Offset credits are issued from projects developed using ARB-adopted compliance offset protocols. Compliance offset protocols contain the project eligibility criteria to ensure reductions are additional, quantification methodologies and regulatory verification and enforcement requirements, as required by AB32. Therefore, they represent the standard by which offset projects are reviewed and judged. They contain the basic methods and procedures to conduct the offset project and determine the greenhouse gas reduction benefits. AB 32 also requires that offsets be "real, permanent, quantifiable, verifiable, enforceable, and additional."

C. ARB Transition to Compliance Offset Protocols

In order to encourage early actions to reduce greenhouse gas (GHG) emissions, the Board decided to adopt GHG emission reduction project protocols starting in 2007. In October 2007, the Board adopted its first Forest Project Protocol, Version 2.1 developed by the Climate Action Reserve (CAR). In September 2008, the Board adopted the Livestock Manure Project Protocol Version 2.1 and Urban Forest Protocol Version 1.0, also for early action projects. Finally in September 2009, the Board adopted the Forest Project Protocol Version 3.0, an update to Version 2.1 to enable greater participation in forest projects. The Ozone Depleting Substances Project Protocol Version 1.0 was adopted by CAR in early February 2010, and the timing precluded it from being adopted by the Board.

The adoption of the protocols represented the Board's endorsement of technically sound approaches for carbon accounting for early action projects. Each of these protocols were developed by CAR and taken through an ARB public review process before they were adopted by the Board.

At its February 2010 meeting, the Board requested staff to initiate a public process to transition the protocols for use as compliance offset protocols for compliance purposes in the proposed cap-and-trade program. The Board rescinded approval of the early action protocols in order to begin the transition to a regulatory compliance offset program. Staff began the process by reviewing updates made to the early action protocols since the Board adopted them. On June 23, 2010, ARB staff held a public workshop to discuss the four protocols that were under consideration for modification to align with criteria in AB 32 and the proposed cap-and-trade rule.

D. Compliance Offset Protocol Structure and Regulatory Requirements

Offset protocols consist of two main structural elements, project requirements and project quantification. Project requirements include items such as eligibility, monitoring and reporting, and verification and enforcement provisions. AB 32 requires ARB to adopt regulatory requirements for verification and enforcement of any offset reductions used for compliance purposes. Project quantification identifies the quantification methodologies and equations used in project accounting such as baseline determination and calculation of emissions and emission reductions.

Compliance offset protocols will be incorporated by reference into the proposed cap-and-trade regulation. This incorporation makes the offset protocol document an enforceable regulation. AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA), 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 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.

Since the protocols will now be used in the context of a compliance program, staff has modified language in the protocols to refer to the regulatory requirements in the proposed cap-and-trade regulation where needed rather than splitting the protocols into separate documents based on regulatory requirements and quantification methodologies. In sections where there is a regulatory

requirement in the cap-and-trade regulation, staff refers readers to the appropriate section in the rule.

In addition, the proposed cap-and-trade rule includes offset program regulatory requirements, including but not limited to, eligibility criteria for start dates, project locations, offset project reporting periods, project document retention, project listing information, project reporting information, verification requirements, permanence mechanisms for sequestration projects, and enforcement provisions. Where there are regulatory requirements in the cap-and-trade rule, staff has modified language in the protocol to align with the rule.

E. Environmental Impacts

The California Environmental Quality Act (CEQA) and ARB policy require an analysis to determine any potentially adverse environmental impacts of any potential projects under the compliance offset program. ARB determined that adoption and implementation of the proposed compliance offset protocols constitute "projects" as defined by Public Resources Code §21000 et seq. The CEQA Guidelines, §15378 provides the definition of a project. ARB has included a tiered environmental review of the proposed cap-and-trade regulation, the offset program, and subsequently adopted compliance offset protocols in the cap-and-trade regulation at section 95973.

II. Compliance Offset Protocol for Forest Projects

A. Role of Forests in Climate Change Mitigation

Forests play an essential role in climate change mitigation through their capacity to remove carbon dioxide from the atmosphere through photosynthsis, and sequester carbon for long periods of time in various biomass carbon pools. 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. Through sustainable management and protection, forests can help address global climate change. The Forest Offset Protocol is designed to address the forest sector's unique capacity to sequester, store, and emit CO_2. Specifically, there is a significant climate change mitigation opportunity for forests through the reforestation of non-forest or previously deforested lands, forest management activities to increase carbon stocks, and the avoided conversion of at-risk forest lands.

B. Development of the Protocol

CAR began work on the Forest Protocol in April 2003 in response to a mandate set out in California Senate Bill 812. The bill required the establishment of protocols to encourage carbon sink activities by creating an incentive for forest landowners to undertake forest conservation, conservation-based management, and reforestation projects. In October 2007, the Air Resources Board adopted Version 2.1 of the Forest Protocol as a rigorous GHG accounting framework for voluntary purposes. The Board also recognized the need to develop additional methods to encourage greater participation in forest projects, and directed ARB staff to initiate a process to update the Forest Protocol to reduce barriers to participation, while maintaining sound accounting principles.

ARB staff contracted with CAR to lead the update process. A Forest Project Protocol Workgroup was formed to identify and work through major issues to update the protocol. The Workgroup consisted of stakeholders representing forest industry, public lands, non-governmental organizations, government agencies, and academia. CAR and ARB held several joint public workshops over the course of the protocol update process and gathered stakeholder input. The update process was completed in September 2009, and Version 3.0 was adopted by both CAR and ARB. After the Board's approval of Version 3.0, CAR approved a Version 3.1, which clarified language on silvicultural practices and requirements for balancing age and habitat classes.

Following the adoption of Version 3.1 by CAR's Board, there emerged a need to clarify what constitutes a legal constraint when modeling a project's baseline. CAR initially released draft guidance in February 2010 on the question of whether certain California forest management planning documents should be considered legal constraints when determining a project baseline. CAR held a public workshop on the issue in March 2010, before releasing a final staff baseline proposal on June 24, 2010 that included some revisions to the baseline methodology in Version 3.1. In examining the issue of how to account for documents related to California Forest Practice Rules requirements regarding Maximum Sustained Production of High Quality Wood Products, CAR also received comment on the potential for Forest Owners to employ a selection bias in defining a project area, and on Habitat Conservation Plans and Safe Harbor Agreements. CAR incorporated changes into Version 3.2 which requires that Habitat Conservation Plans, Safe Harbor Agreements, and active Timber Harvest Plans be included in the baseline modeling as regulatory constraints, but other long-term planning documents ('Option A' or 'Sustained Yield Plans') do not. It also includes a revised baseline approach to prevent selection bias in defining a project area that takes into consideration the existing carbon stocks on all of a

forest entity's holdings within a logical management unit and new guidance for aggregating forest projects. Version 3.2 was adopted by CAR's Board In August of 2010.

In February 2010, the ARB Board withdrew its previous adoption of voluntary protocols and directed ARB staff to focus efforts on transitioning the voluntary protocols to a form that could function within the state's regulatory cap-and-trade program. ARB used CAR's Forest Project Protocol Version 3.2 as the basis for transitioning to a compliance protocol.

C. Description of the Protocol

Overview

ARB's Compliance Offset Protocol for Forest Projects (Forest Offset Protocol) allows offset project developers in the United States to quantify greenhouse gas emission reductions and removal enhancements associated with forest management activities. 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.

ARB's Forest Offset Protocol is based on Version v3.2 of CAR's voluntary Forest Project Protocol (CAR Protocol). ARB Staff has conducted a detailed review of the quantification methodologies contained in CAR's protocol and believes Version 3.2 represents a detailed and rigorous accounting methodology to quantify GHG emission reductions or removal enhancements from forest projects. The CAR Protocol has greatly benefited from nearly seven years of revisions and use in voluntary forest projects. As the CAR Protocol was developed and updated through the dedicated effort of stakeholder working groups, it has evolved to incorporate the technical and practical input of a wide range of experts. The CAR Protocol quantification methodologies take a conservative approach where uncertainty exists and are structured to ensure that quantified reductions or removals are real, additional to regulatory obligations, maintained for a long period of time, and quantifiable. In addition, the CAR Protocol addresses defining project boundaries, assessing additionality and modeling crediting baselines, quantifying relevant carbon pools, and accounting for the risks of reversals and emissions leakage.

ARB's Forest Offset Protocol covers three types of forest projects:

- *Reforestation Projects*, which involve planting trees on land that has been out of forest cover for at least 10 years or has been subject to a recent significant disturbance.

- *Improved Forest Management Projects*, which involve undertaking management activities to maintain and increase carbon stocks on forested lands.
- *Avoided Conversion Projects*, which involve preventing the conversion of high-risk forestland to a non-forest land use by dedicating the land to continuous forest cover through a conservation easement or transfer to public ownership.

Projects on both private and public lands are eligible.

For purposes of ARB's Forest Offset Protocol, a Forest Owner is defined as the owner of any interest in the property involved in a Forest Project. Generally, a Forest Owner is the legal land owner (owner in fee) of the property involved in a Forest Project. In some cases, one entity may own the land 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 property are collectively considered the Forest Owners, however, a single Offset Project Operator must be identified.

The Offset Project Operator is responsible for undertaking a forest project and ensuring the requirements of the protocol are adhered to, and that all local, regional, and federal requirements are met, however, all Forest Owner(s) are ultimately responsible for all forest project commitments. The Offset Project Operator is responsible for project listing, monitoring, reporting, record retention, and verification activities. Projects are not eligible to receive offset credits for GHG reductions that occur as the result of forest management activities that are not in compliance with all regulatory requirements.

ARB's Forest Offset Protocol also requires forest projects to employ natural forest management, demonstrate sustainable harvesting practices, and maintain or increase live tree biomass over the life of the project. The Forest Offset Protocol also includes provisions that require the use of native species, and prohibit broadcast fertilization. Implementing a forest project does not prevent Forest Owners from managing their lands for timber resources, but rather allows Forest Owners to receive credit for actions taken to maintain and increase carbon sequestration and avoid emissions on their lands.

Additionality

ARB's Forest Offset Protocol requires that any credited reductions be in addition any GHG reductions or removals that would occur through law or regulation, and in addition to what would otherwise occur under a business as usual scenario. Projects must satisfy both a Legal Requirement Test and a Performance Test for additionality, and the protocol contains specific guidance on setting a baseline to ensure only additional reductions are credited. For example, all modeled project baselines must incorporate all legal constraints. Reforestation Projects must demonstrate that the land has been out of forest cover for 10 years, or where a

recent significant disturbance has occurred, demonstrate that reforestation would not be expected to be financially viable without the project or occurs in an area not historically subject to tree harvesting. Improved Forest Management Projects must take various factors into consideration when setting the project baseline, such as carbon stocking levels relative to comparable lands (common practice), historic management practices (high stocking reference), management of other entity forest lands within a logical management unit, financial feasibility of the baseline model, as well as the current stocking levels and legal constraints on the management of project lands. Avoided Conversion Projects must demonstrate both that the conversion of project lands is legally permissible, and through a real estate appraisal, that the project area is suitable to conversion to an identified alternative use, and that the alternative use has a significantly higher market value than maintaining the area as forest land.

Permanence

To ensure permanence, all forest projects commit to maintain all credited emission reductions or removal enhancements for 100 years following the issuance of any offset credit for GHG reductions or removals achieved by the project. For example, if offset credits are issued to a forest project in year 24 following its start date, monitoring and verification activities must be maintained until year 124.

Because GHG reductions and removals from forest projects can be “reversed” if the stored carbon associated with them is released (back) to the atmosphere, mechanisms to ensure permanence are included in the protocol. Many biological and non-biological agents, both natural and human-induced, can cause reversals. Some of these agents cannot completely be controlled and may therefore result in an unintentional reversal, 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 offset protocol, reversals due to controllable agents are considered intentional. If the quantified GHG reductions and removals in a given year are negative, and offset credits were issued to the forest project in any previous year, it is considered a reversal, regardless of the cause of the decrease.

Permanence of forest project GHG reductions and removals is addressed through three mechanisms:

1. The requirement for all 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 (which is 100 years from the date of the last offset credit issuance).

2. The regulatory obligation for all intentional reversals of GHG reductions and removals be compensated for through retirement of other Compliance Instruments.
3. The maintenance of a Forest Buffer Account by ARB to provide insurance against reversals of GHG reductions and removals due to unintentional causes (including natural disturbances such a fires, pest infestations, or disease outbreaks).

Unintentional reversals are insured against by contributing a percentage of ARB issued Offset Credits to the Forest Buffer Account. All forest projects must contribute a percentage of issued offset credits to the Forest Buffer Account any time compliance credits are issued by ARB. The amount of the contribution is based on a project-specific risk evaluation. If a forest project experiences an unintentional reversal, offset credits from the Forest Buffer Account will be retired in an amount equal to the total amount of carbon that was reversed.

If a reversal is found to be intentional, then the Offset Project Operator or Authorized Project Designee must compensate for the reversal by surrendering compliance instruments from its account equal to the size of the reversal in CO_2-equivalent metric tons.

A forest project will be automatically terminated if a significant disturbance occurs leading to an unintentional 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 Forest Buffer Account covers the unintentional reversal and the project has no further obligations to under this offset protocol.

A forest project is automatically terminated if project lands are sold to an entity that does not elect to take over project responsibilities and commitments. Such a termination will require a sufficient quantity of compliance instruments to be retired equal to the amount of offset credits issued to the project over the previous 100 years (or the life of the project if less than 100 years) multiplied by the appropriate compensation rate as set forth in the protocol.

A forest project may be voluntarily terminated prior to the end of its crediting period if the required quantities of compliance instruments are retired. For a Reforestation or Avoided Conversion Project, a quantity of compliance instruments equal to the total number of offset credits issued to the project over the preceding 100 years must be retired. For an Improved Forest Management Project, a quantity of compliance instruments equal to the amount of offset credits issued to the project over the previous 100 years (or the life of the project if less than 100 years) multiplied by the appropriate compensation rate as set forth in the protocol must be retired.

Quantification Methodology

Quantification in the Forest Offset Protocol is based on the accounting of carbon stored or emitted from various carbon pools included in the project boundary (in CO_2-equivalent units). All forest projects must account for carbon in standing live tree biomass (above and below ground), standing dead wood, and harvested wood products. In addition, Reforestation Projects must account for carbon in shrubs and herbaceous understory. Projects that involve intensive site preparation activities where soil disturbance exceed more than 25% of project area lands must account for soil carbon. Each project must develop and maintain a forest carbon inventory program. Forest carbon stocks for required carbon pools are quantified primarily through field inventories. Based on the sampling error of the inventory, a statistical confidence deduction may be applied to the carbon stocks to address measurement uncertainty. Sample plots used to develop or update the inventory must never be older than 12 years, and projects are allowed to update their forest carbon inventories using approved models. These models allow projects to account for harvesting and growth and in years when sample plots are not directly measured. Modeled plot data would need to be modified if contradicted by a verification site-visit or future plot measurements.

The Forest Offset Protocol also includes standard approaches and factors for accounting for potential for some increases in GHG emissions outside of the project boundary as a result of the project activity. This is known as emissions leakage. For example, to account for the potential of other forests lands to increase harvesting as a result of reduced harvesting on project lands, the protocol applies a standard factor to annual harvest figures. There are also methods for quantifying the emissions risk of displacing other land uses in reforestation and avoided conversion projects.

Annual project greenhouse gas emission or removals are compared to the project baseline to determine the net emission reductions or removal enhancements eligible for offset crediting.

Monitoring, Reporting, and Verification

Annual project data, including annual GHG reductions or removal enhancements (or reversals), is submitted to ARB for each calendar year in the Offset Project Data Report. Offset project data reports must be verified by an accredited third-party verification body at least once every six years, and all verifications must include a site visit. Each verification will evaluate the emission reductions, removal enhancements or reversals for each calendar year over the period since the last verification was conducted. While verification may take place less often than annually, each calendar year of reported data since the last verification must be verified in years that it occurs. ARB only issues offset credits for verified emission reductions or removal enhancements. For example, a project that has six years of data verified at one time would only be issued offset credits for those years following successful verification of the data.

Project monitoring procedures must be documented in the forest carbon inventory program. The inventory data must be updated each year to account for growth, harvest, and any disturbances or reversals if applicable. Updating the inventory may include incorporating new plot data, modeling, harvest data, or a combination of these.

III. Specific Changes from the Voluntary Protocol

A. Specific Changes from the Voluntary Protocol

The proposed Compliance Offset Protocol for Forest Projects is based on CAR's version 3.2, which includes clarifications and amendments to version 3.1. ARB recognizes the tremendous amount of time and energy that went into drafting each version of the Forest Protocol, and the broad consensus it has achieved on many contentious technical and policy issues. After receiving public comment on the protocol following the June 23rd workshop, ARB staff is not proposing significant modifications to the protocol. The majority of changes were made to align the protocol with the cap-and-trade program. The most significant modifications relate to the enforcement of projects through regulation rather than through legal contracts, and modification of the project crediting period to align with the cap-and-trade regulation. Verification provisions were also revised, to align with ARB's regulatory verification requirements. The following details specific changes made to transition the voluntary forest protocol to an ARB compliance offset protocol. These and other minor modifications are detailed below.

<u>Programmatic changes to align with cap-and-trade program requirements</u>:
A number of programmatic changes were necessary to align the protocol text with the processes and requirements in the cap-and-trade regulation. These relate both to the transition from a voluntary to a regulatory program generally, and specifically the transition from a program administered by CAR to one administered by ARB. These modifications included modifying references to ARB's program and regulatory text, eliminating some forms not required by ARB, and aligning start date eligibility and project commencement requirements with the regulation. Sections containing quantification methodologies were clearly identified, as these are exempt from the APA process. References to CAR's website were changed to reference ARB's website where protocol related documents will be housed. A requirement was also added that projects must fulfill all applicable local, regional, and national requirements on environmental impact assessments to be eligible.

Some areas where the protocol may have been unclear or less standardized were modified to be consistent with a regulatory program. For example, where

'variances' were allowed, they was replaced with requirements for submitting written documentation. Words such as 'guidance' were changed to 'requirements' or 'methods' as appropriate, and words such as 'should' to 'must' to improve clarity and consistency. 'Recommended' methodologies were replaced with language that specifies the methodology as appropriate.

Language was also added to delineate some specific requirements for Qualified Conservation Easements. Most notably, a Qualified Conservation Easement must 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 conveyed to the holder of the easement. These rights must include standing as an interested party in any proceeding affecting the easement.

Definition and terminology changes to align with cap-and-trade program:
A number of modifications were made to the protocol to align glossary definitions and terminology used in the protocol with the cap-and-trade regulation. It is important to maintain consistency in the use of terms, and that definitions in the protocol not conflict with ARB program requirements. For example, the definition of 'Forest Owner' was modified to align with liability requirement in cap-and-trade.

Examples of other terminology changes include:

- 'Project Developers' changed to 'Offset Project Operators' or 'Authorized Project Designees';
- 'Avoidable' and 'Unavoidable' were changed to 'Intentional' and 'Unintentional';
- 'Buffer Pool' changed to 'Forest Buffer Account';
- 'GHG Assessment Boundary' changed to 'Offset Project Boundary';
- 'Project Start Date' changed to 'Offset Project Commencement';
- 'Annual Monitoring Report' changed to 'Offset Project Data Report', and the 'Project Design Document' requirements were incorporated into the initial offset project data report.

Permanence Mechanisms:
The definition of permanence was modified to align with the cap-and-trade regulation, which defines permanence as "…when GHG reductions or removal enhancements may be reversible, that mechanisms are in place to replace any reversed GHG emission reductions or removal enhancements to ensure that all credited reductions endure for a period that is comparable to the atmospheric lifetime of an anthropogenic CO2 emission." The permanence mechanisms currently in the protocol are designed to fulfill this requirement by ensuring that all crediting GHG reductions or removals are maintained for 100 years. No significant changes to the permanence mechanisms in the protocol were made,

except as related to the enforcement and administration of the permanence mechanisms.

CAR's Forest Protocol relies on a binding legal contract known as a Project Implementation Agreement (PIA) between the Forest Owner and CAR to identify a Forest Owner's obligations with respect to maintaining the permanence of credited reductions, as well as other project obligations. The PIA provides the basis for any enforcement action under CAR's program. References to CAR's Project Implementation Agreement have been removed from ARB's Forest Offset Protocol, as ARB will ensure compliance with protocol requirements through regulatory enforcement rather than through contracts. ARB staff determined that in a regulatory context a legal contract would not be necessary because as soon as an Offset Project Operator submits project information to ARB, they become subject to ARB's enforcement provisions.

ARB also modified the requirement to replace carbon released due to intentional reversals (including project termination) exclusively with other forest offsets. ARB will allow intentional reversals to be compensated for with any ARB-issued or approved compliance instruments (i.e. allowances or offset credits). CAR's protocol required that forest credits be only replaced with other forest offset credits to recognize the co-benefits of forest projects and the preferences of offset buyers in the voluntary market to ensure their investment remained in forest projects. However, ARB has concerns regarding the potential availability of forest offset credits in the event of a large intentional reversal such as project termination (where credits would need to be purchased in a single year to compensate for offsets that were potentially issued over many years). ARB also considers it important to maintain fungibility across all ARB compliance instruments in the cap-and-trade program.

<u>Verification and Enforcement</u>:
AB 32 specifically requires any greenhouse gas reductions used for compliance purposes to be verified and enforced through regulatory requirements adopted by ARB. The verification and enforcement requirements in the protocol have been revised align with ARB's regulatory requirements. The proposed cap and trade rule contains the requirements for a third-party offset verification process by ARB accredited verifiers, a conflict of interest review process, and regulatory requirements for providing verification services. Verification of offsets projects under ARB relies on the verification program requirements outlined in the regulation. The protocol was modified to reference ARB verification requirements and identify only specific verification tasks that must be conducted as part of or in addition to the regulatory requirements. Verification text in CAR's protocol was largely revised or removed, as much of the text included a restatement of protocol requirements and guidance on verifying those specific requirements. As ARB's verification program requires conformance will all protocol requirements, most of the CAR verification text that was removed will be incorporated into to a

future verification guidance document. Examples of specific verification requirements unique to forest projects detailed in the protocol include:

- Review of all project listing information during initial verification;
- Detailed review of forest carbon inventory program during each verification;
- Re-measurement and analysis of a selection of sample plots to ensure the sample plots used to develop the forest inventory were measured accurately;
- Review of conformance with natural forest management and sustainable harvesting provisions (non-conformance with these provisions will automatically result in an adverse verification statement);
- Requirement that each verification team include at least one Professional Forester that takes in active role in reviewing the forest carbon inventory program and conducting the site visit.

All mechanisms for the enforcement of forest project offsets are included in the proposed cap and trade regulation, and ARB will have oversight authority over the regulatory offset verification program. The regulation also specifies liabilities for the various parties participating in the cap and trade program. References to the Project Implementation Agreement in the protocol were removed, as regulatory enforcement will no longer be handled through contracts.

The Project Implementation Agreement also addressed the obligations of Forest Owners if project lands are sold. To address this in ARBs protocol, language was added to the 'Minimum Time Commitment' exceptions to specify that a Forest Project automatically terminates if Project Lands are sold to an entity that does not elect to take over project responsibilities and commitments. Such a termination is considered an intentional reversal and will require a quantity of compliance instruments equal to the amount of offset credits issued to the project over the previous 100 years (or the life of the project if less than 100 years) multiplied by the appropriate compensation rate (as applicable) to be retired.

Crediting Periods:
CAR's Forest Protocol currently employs a single crediting period of 100 years. The draft cap-and-trade regulation, however, requires a crediting period of 10-30 years for projects that involve carbon sequestration, with a possibility to renew at the end of each crediting period. ARB staff modified the protocol to include a crediting period of 25 years for forest projects, without any explicit limitation on the number of potential renewals. Monitoring, verification and replacement of all carbon lost through reversals is required for 100 years following the last issuance of any offset credits, consistent with the CAR's current protocol. Each project is required to move to the latest version of ARB's protocol at the end of the crediting period as a condition of renewal. It is ARB staff's expectation that forest projects will generally remain eligible for renewal provided that they transition to the latest compliance protocol as a condition of renewal. This ensures that all

projects use the latest factors, and reduces the number of versions of the protocol that could potentially be in use after a period of time to assist with project verification. For example, Forest Buffer Account contribution factors, and emissions leakage factors will likely be updated in the future as better information becomes available. Transitioning projects to the most recent approved protocol will help ensure that offset credits in ARB's program are quantified using the best available science, and reduce the administrative burden of having projects operating under many different versions of the Forest Offset Protocol as it is updated over the years.

Baseline adjustment for over-stocked private lands:
CAR's protocol includes a revised baseline approach to prevent selection bias in defining a project area that takes into consideration the existing carbon stocks on all of a Forest Owner's holdings within a logical management unit. A number of stakeholders have proposed a modification to this approach that would apply this adjustment only to relatively under-stocked areas, and not apply it to overstocked areas. This was intended to incentivize projects in mature forest stands that are perceived to be at greater risk of harvest. ARB staff has incorporated this proposal into the Forest Offset Protocol.

Specifically, the baseline approach for Improved Forest Management Projects on private lands has been modified so that projects with initial carbon stocks greater than the average stocking on all of a Forest Owner's (and its affiliate's) other lands within a logical management unit would receive some credit for avoiding the harvest of existing stocks. However, projects with carbon stocks that are at least 20 percent lower than the entity average within the same management unit must adjust their baseline to reflect management practices on the Forest Owner's other landholdings. This approach disallows project selection bias and crediting of non-additional carbon in the case of selecting areas with low stocking that would are expected to grow regardless of the project. However if project lands are selected due to their higher stocking, a baseline adjustment will not be required. While offset credits in this case would be issued for existing carbon stocks above the common practice benchmark, crediting higher stocked areas without a baseline adjustment provides an incentive to place older growth, high stocked areas into projects, resulting in the long-term protection of these forests and their associated co-benefits. Highly stocked areas are more likely to be at risk of harvest due to a greater quantity of merchantable timber, and as a result, projects that ensure carbon stocks in older growth areas will be maintained and increased are considered to be additional to business as usual.

Project Aggregation:
CAR's Protocol incorporates by reference guidelines for the aggregation of small forest projects. Aggregation rules are intended to encourage small landowner participation by reducing forest inventory and verification requirements and costs for individual Forest Owners that participate, while still maintaining the same high

degree of inventory accuracy for the aggregated projects as a whole. At this time ARB staff is not including project aggregation in the Forest Offset Protocol. ARB staff recognizes the significant potential benefits for the environment and offset supply of lowering barriers to participation for small Forest Owners. However, as aggregation rules were a very recent addition to CAR's protocol, ARB staff has not yet worked through the details of its compatibility within the compliance offset program, and any modifications that may be needed for aggregation to function within ARB's program.

Projects on Federal Lands:
ARB's Forest Offset Protocol allows for the eligibility of projects on public lands, and the protocol can readily be applied to projects on state and local government owned forest lands. However, projects on federal lands present an added level of complexity that requires further study before ARB will be able to accept projects on federal lands.

CAR's Forest Protocol requires approval by government agencies with responsibility for forest management activities for all projects on public lands, and specifically for federal lands it states, "projects on federal lands may be eligible if and when their eligibility is approved through a federal legislative or regulatory/rulemaking process." In ARB's Forest Offset Protocol, the provision on federal land eligibility has been removed until the technical and policy contexts of these projects are better understood. ARB staff recognizes the large potential for emission reductions and removals on federal forest lands, but feels that offset projects on federal lands would necessitate further review and potential revisions to the protocol at a later point.

Exclusion of Optional Carbon Pools:
To maintain consistency in project accounting and reporting, and because the methodologies for many of the optional pools are less standardized and carry with them more uncertainty, optional pools have been excluded from project accounting. Standardizing all carbon pools to be either required or excluded will increase accounting consistency and limit crediting to carbon pools that have a significant impact on the project accounting and are more readily quantifiable. References to optional pools, including the inventory requirements for those pools, have been removed.

Documentation Required for a Forest Carbon Inventory:
The CAR protocol requires Forest Owner's to develop and describe a methodology to sample for biomass or volume of all required carbon pools. While the protocol includes guidance and reference documents for developing the inventory methods for the various carbon pools, and specified requirements for inventory accuracy based on sampling error, Forest Owners are given discretion in developing their inventory program and methodologies subject to verifier approval. In order to provide more guidance to Forest Owners and

ensure that forest inventory methodologies are readily verifiable, ARB staff has expanded some of the guidelines in Appendix A – Developing an Inventory of Forest Project Carbon Stocks. The purpose of these modifications is to ensure transparency and consistency in the documentation of forest carbon inventory programs, which will in turn make the programs more readily verifiable. This is not so much a change to existing protocol requirements (as most of these items are already required by the protocol), as a clarification of expectations for documenting a forest carbon inventory program. ARB will require all forest projects to develop a documented forest carbon inventory program that explicitly includes:

- Description of project boundary, including a list of all included carbon pools;
- Description of the inventory sampling methodology used to quantify each carbon pool, with references clearly documented;
- Standard procedures for the collection of field measurements that include a description of the types of sample plots, location of plots, and frequency for updating or replacing sample plots;
- Standard procedures for where and how to measure parameters used in biomass calculations such as dbh and height (including for irregular trees);
- Documentation of inventory stratification rules, if applicable;
- Documentation of all analytic methods and biomass equations used to translate field measurements into volume or biomass carbon estimates;
- Documented quality assurance / quality control (QA/QC) plan that includes procedures for assessing and ensuring the quality of collection, transfer and archiving of field data, data entry and analysis, and any other relevant procedures to ensure quality and consistency in the collection and maintenance of data used to compile offset project data reports;
- Description of data management systems and processes, including the collection, storage and analysis of inventory related data analytical methods to translate field measurements into volume and/or biomass estimates;
- A change log documenting any changes in the inventory methods or equations used to calculate carbon stocks;
- Standard procedures for updating the forest carbon inventory, including documented procedures to account for harvest, growth, and disturbance; incorporation of new inventory and plot data, and retiring older sample plots; use of modeling, and application of appropriate confidence deduction.

The forest carbon inventory program will be reviewed by a verifier in detail during verification, and will be made available to ARB upon request. In determining requirements for a forest carbon inventory program, ARB staff consulted recent guidance produced by CAR on developing forest carbon inventories that had not previously been incorporated into the protocol. ARB staff also incorporated some

of the recommendations included in a 2004 report prepared by Winrock International for the California Energy Commission's PIER Program entitled "Methods for Measuring and Monitoring Forestry Carbon Projects in California."

Sample Plot Age Requirement:
ARB's Forest Offset Protocol requires that all sample plot data used to develop and update the forest carbon inventory have been sampled within the last twelve years. The protocol includes flexibility allowing varying sampling approaches, from sampling all plots once every twelve years to sampling a twelfth of the plots used to develop the inventory each year, so long as no plot data is older than twelve years. In the interim years, forest carbon models may be used to update the inventory. The CAR protocol contained an exception that allowed plot measurements to be up to 18 years old when Forest Owners could demonstrate that the process used to update the inventory adequately estimates the forest carbon inventory. ARB staff has removed this exception in the Forest Offset Protocol. ARB staff believes that relying on forest inventory modeling for too long increases the uncertainty of carbon stock estimates, and that 12 years should provide sufficient time to update sample plots.

Clarification of Promotion of Onsite Standing Live Carbon Stocks Requirement
ARB staff added several sentences to the section of the protocol requiring promotion of onsite standing live carbon stocks. ARB staff do not view this modification as a change to existing requirements, but rather as a clarification of the existing requirement to that all projects must maintain and increase standing live carbon stocks over the life of the projects. Specifically, over any consecutive 10 year period, projects must indicate an increase in standing live carbon stocks. There are four exceptions to this requirement that indicate under what circumstances a project's standing live carbon stocks may decrease, such as an unintentional reversal or temporary decreases that are part of normal silvicultural cycles on smaller project areas.

To the exceptions based on either a planned balancing of age classes or normal silvicultural cycles, ARB added the sentence, "Over any consecutive 10-year period, average standing live carbon stocks must be maintained at or above the standing live carbon stocks at the initiation of the project." This clarifies the intent of the requirements in this section by clearly not allowing a planned balancing of age classes to fall below initial carbon stocks (for example, if initial carbon stocks started above the project baseline and common practice). Also, the language was clarified that the requirement that, "At no time shall the Forest Project's inventory of standing live carbon stocks fall below the Forest Project's baseline 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," applies to a planned balancing of age classes as well as to normal silvicultural operations.

IV. References

CAR (2010) Forest Project Protocol Version 3.2. August 21, 2010. http://www.climateactionreserve.org/wpcontent/uploads/2009/03/Forest_Project_Protocol_Version_3.2.pdft/ (accessed September 9, 2010)

California Environmental Protection Agency

AIR RESOURCES BOARD

Compliance Offset Protocol for Forest Projects

Adopted: [INSERT Date of Board Adoption]

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Abbreviations and Acronyms

ARB	Air Resources Board
C	Carbon
CH_4	Methane
CO_2	Carbon dioxide
FIA	Forest Inventory and Analysis Program of the U.S. Forest Service
GHG	Greenhouse gas
lb	Pound
IFM	Improved Forest Management
N_2O	Nitrous oxide
Regulation	Cap-and-Trade Regulation, title 17, California Code of Regulations, sections 95800 et seq.
USFS	United States Forest Service

1 Introduction

The Compliance Offset Protocol for Forest Projects (Forest Offset Protocol) provides requirements and methods 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 as the basis for issuing Offset Credits. The protocol is built off of The Climate Action Reserve's Forest Project Protocol Version 3.2[1].

Offset Project Operators or Authorized Project Designees must use this protocol to quantify and report GHG reductions and removal enhancements. The protocol provides eligibility rules, methods to quantify reductions, project-monitoring instructions, and procedures for reporting offset project data reports. Additionally, all projects must submit to independent verification by ARB-accredited verification bodies. Requirements for verification bodies to verify offset project emissions data reports are provided in the Cap-and-Trade regulation (Regulation).

AB 32 exempts quantification methodologies from the Administrative Procedure Act (APA)[2], 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 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.

[1] CAR (2010) Forest Project Project Protocol Version 3.2. August 31, 2010. http://www.climateactionreserve.org/wpcontent/uploads/2009/03/Forest_Project_Protocol_Version_3.2.pdft/ (accessed September 9, 2010)

[2] Health and Safety Code section 38571.

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 Forest Offset Protocol 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 this protocol, 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 11 of this protocol. Throughout the protocol, important defined terms are capitalized (e.g. "Reforestation Project").

2.1 Project Types

The following types of Forest Project activities are eligible:

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 it can fully satisfy the eligibility rules in the Regulation and:

1. The project involves tree planting or removal of impediments to natural reforestation, on land that:
    a. Has had less than 10 percent tree canopy cover for a minimum of 10 years; or
    b. Has been subject to a Significant Disturbance that has removed at least 20 percent of the land's above-ground 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 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 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.
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 10 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 listed and verified Forest Project, unless the previous Forest Project was terminated due to an Unintentional Reversal (see Section 7).

Reforestation Projects on both private and public lands, excluding federal lands, are eligible.

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 it can fully satisfy the eligibility rules in the Regulation and:

1. The project takes place on land that has greater than 10 percent tree canopy cover.
2. The project employs natural forest management practices, as defined in Section 3.8.2 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 listed and verified Forest Project, unless the previous Forest Project was terminated due to an Unintentional 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 on both private and public lands, excluding federal lands, are eligible.

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 through a Qualified Conservation Easement or transfer to public ownership, excluding transfer to federal ownsership. An Avoided Conversion Project is only eligible if it can fully satisfy the eligibility rules in the Regulation and:

1. It can be demonstrated 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 listed and verified Forest Project, unless the previous Forest Project was terminated due to an Unintentional Reversal (see Section 7).

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

Avoided Conversion Projects are eligible only on lands that are privately owned prior to offset project commencement.

2.2 Forest Owners

A Forest Owner is the owner of any interest in the property involved in a Forest Project, but does not include the holder of a conservation easement. Generally, a Forest Owner is the legal land owner (owner in fee) of the property involved in a Forest Project. In some cases, one entity may own the land 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 property are collectively considered Forest Owners, however, a single Offset Project Operator must be identified.

The Offset Project Operator is responsible for undertaking, listing, and verifying a Forest Project, however, all Forest Owner(s) are ultimately responsible for all Forest Project commitments. The Offset Project Operator may identify an Authorized Project Designee pursuant to §95974 of the Cap-and-Trade Regulation, to assist or consult with implementation of the Forest Project. All information submitted to ARB or an Offset Registry shall reference the Offset Project Operator and all Forest Owner(s) who are ultimately responsible for the accuracy and completeness of the information submitted.

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 listing, and must adhere to requirements in the Regulation and requirements related to duration and crediting periods.

3.1 Additionality

Eligible offsets must be generated by projects that yield surplus GHG emission reductions or removals that exceed any GHG reductions or removals otherwise required by law or regulation, or any GHG reduction or removal that would otherwise occur in a conservative Business-As-Usual Scenario. Forest Projects must satisfy the following to be considered additional:

1. 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, 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. Legally binding mandates also include conservation easements or deed restrictions, except where such conservation easements have been enacted in support of the Forest Project, as described in Section 3.5. This requirement is assessed through the Legal Requirement Test in 3.1.1.
2. 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 Regulation and the requirements described below (Section 3.1.2). This requirement is assessed through the Performance Test in Section 3.1.2.

3.1.1 Legal Requirement Test

To meet additionality requirements, the following legal requirement test must be met, specific to each type of Forest Project.

3.1.1.1 Reforestation Projects

Reforestation Project activities cannot be legally required (as defined above) at the time of offset project commencement. 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

Improved Forest Management Project activities (defined as management activities intended to maintain or increase carbon stocks relative to baseline levels) cannot be legally required (as defined above) at the time of offset project commencement. Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.2 of this protocol.

3.1.1.3 Avoided Conversion Projects

Avoided Conversion Project activities cannot be legally required (as defined above) at the time of offset project commencement. Modeling of the project's baseline carbon stocks must reflect all legal constraints, as required in Section 6.3 of this protocol.

Official documentation must be submitted demonstrating that the type of anticipated land use conversion is legally permissible. Such documentation must fall into at least one of the following categories:

1. 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.
2. 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.)
3. 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.)

3.1.2 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 less than 10 percent tree canopy cover for at least 10 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 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 has not historically engaged 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 conservative 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 a real estate appraisal for the Project Area (as defined in Section 4) is submitted 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.
    a. At a minimum, where conversion to commercial, residential, or agricultural land uses is anticipated, the appraisal must indicate that the slope of Project Area land does not exceed 40 percent.
    b. Where conversion to agricultural land use is anticipated, the appraisal must provide:

i. Evidence of soil suitability for the type of expected agricultural land use.
ii. 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.
d. The appraisal must identify specific portions of the Project Area 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.

2. *The alternative land use for the Project Area has a higher market value than forestland*. The appraisal for the property must 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.

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.

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 the Internal Revenue Code, Section 170 (f)(11)(E)(ii).[4]

3.2 Offset Project Commencement

The date of offset project commencement for a Forest Project is the date on which an activity is first implemented that will lead to increased GHG reductions or removals relative to the Forest Project's baseline. The following actions identify offset project commencement 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.
- 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.

[3] Uniform Standards of Professional Appraisal Practice. http://www.uspap.org/2010USPAP/toc.htm. Accessed 10/01/2010

[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."

An Improved Forest Management project's offset project commencement date must be linked to a discrete, verifiable action that delineates a change in practice relative to the project's baseline..One of the following actions denote an Improved Forest Management project's commencement date:

- Recordation of a conservation easement on the Project Area. The date the easement was recorded is the project's commencement date.
- Transferring of property ownership (to a public or private entity). The project commencement date is the date of property transfer.
- Submitting the project listing information specified in Section 9.1.1. Offset project commencement is the date of submittal of listing information, provided that the project completes verification within 30 months of being submitted. If the project does not meet this deadline, the listing information must be resubmitted under the latest version of the protocol.

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.

3.3 Project Crediting Period

The baseline for any Forest Project under this version of the Forest Offset Protocol is valid until the end of the crediting period following a successful initial verification where the project receives a positive or qualified positive verification statement. This means that after a successful initial verification, a Forest Project will be eligible to receive Offset Credits for GHG reductions and/or removals quantified using this protocol, and verified by ARB-approved verification bodies, for a period of 25 years following the offset project's commencement date. A project may be renewed for subsequent crediting periods, subject to approval at that time and use of the quantification methods in the most recent approved version of the Forest Offset Protocol at the time of renewal. Projects must be listed within 6 months of the offset project commencement date.

3.4 Project Life and Minimum Time Commitment

Project Life is defined as the period of time between offset project commencement and a period of 100 years following the issuance of any Offset Credit for GHG reductions or removal enhancements achieved by the project. Forest Projects must continue to monitor, verify and report project data for a period of 100 years following any Offset Credit issuance. For example, if Offset Credits are issued to a Forest Project in year 25 following offset project commencement, monitoring and verification activities must be maintained until year 125. All Forest Projects must undergo an initial verification that includes a site visit before a project may be issued Offset Credits. After the initial verification all Forest Projects must undergo verification at least once every six years. The only exception to this rule is for Reforestation Projects, which may defer a second verification for up to 12 years. The third and subsequent verifications for Reforestation Projects must continue on at least a six-year cycle.

There are three possible exceptions to this minimum time commitment:

1. A Forest Project automatically terminates if a Significant Disturbance occurs leading to an Unintentional Reversal that reduces the project's Standing Live Carbon Stocks below the project's baseline Standing Live Carbon Stocks. Once a Forest Project terminates in this manner, there are no further obligations under this protocol.

2. A Forest Project automatically terminates if Project Lands 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 Offset Credits to be retired, as specified under 'Retiring Compliance Instruments Following Project Termination,' below.
3. A Forest Project may be voluntarily terminated prior to the end of its minimum time commitment if the required quantity of Compliance Instruments are retired, as specified under 'Retiring Compliance Instruments Following Project Termination,' below.

Retiring Compliance Instruments Following Project Termination

a. For a Reforestation or Avoided Conversion Project, a quantity of Compliance Instruments equal to the total number of Offset Credits issued to the project over the 100 years must be retired.
b. For an Improved Forest Management Project, a quantity of Compliance Instruments equal to the total number of Offset Credits issued to the project over the preceding 100 years, multiplied by the appropriate compensation rate indicated in Table 3.1 must be retired.

Table 3.1. 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
6-10	1.20
11-20	1.15
21-25	1.10
31-50	1.05
>50	1.00

3.5 Use of Qualified Conservation Easements

For Avoided Conversion Projects on private land, the Forest Owner must record a Qualified Conservation Easement against the project's property in order for the Forest Project to be eligible. To be "qualified" for purposes of ARB's compliance offset program, the conservation easement must:

a. Be granted by the owner of the 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;
b. Be perpetual in duration;
c. 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 conveyed to the holder of the easement. These rights include standing as an interested party in any proceeding affecting the easement.

Qualified Conservation Easements must be recorded no earlier than one year before the offset project's commencement date. If a Qualified Conservation Easement was recorded more than

one year prior to the offset project commencement date, the limits imposed by the easement on forest management activities must be considered 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).

As indicated in Section 3.2, an offset project commencement date must be linked to a discrete, verifiable action. 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. 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. Any previously recorded conservation easement must still meet, or be modified to meet, all of the requirements of this section (i.e. expressly acknowledging ARB as a third-party beneficiary) in order to be considered "qualified".

3.6 Project Location

All Forest Projects must be located in the United States of America. 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 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 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. Projects on federal lands are not eligible at this time.

Forest Projects in tribal areas must demonstrate that the land within the Project Area is owned by a tribe or private entities.

The Forest Offset Protocol contains data tables, equations, and benchmark data applicable to projects located in the United States. 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. Improved Forest Management Projects in Alaska and Hawaii are not eligible at this time due to lack of region-specific data.

3.7 Regulatory Compliance

As stated in the Regulation, Project Lands must fulfill all applicable local, regional and national requirements on environment impact assessments that apply based on the offset project location. Projects must also meet any other local, regional, and national requirements that might apply.

Each time the Forest Project is verified, the Offset Project Operator or Authorized Project Designee must attest that the Forest Owner and Project Lands are in compliance with all applicable laws and regulations. The Offset Project Operator or Authorized Project Designee are required to disclose in writing to the verifier any and all instances of non-compliance associated with the Project Lands with any legal requirement. If a verifier finds that a project is in a state of non-compliance with any environmental law or regulation, then Offset Credits will not be issued for GHG reductions that occurred during any calendar year period of non-compliance.

3.8 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. This protocol requires eligible projects to employ both sustainable long-term harvesting practices and Natural Forest Management practices over time, as described below. Any non-conformance with the sustainable harvesting and Natural Forest Management requirements in this section will result in an adverse verification statement during the calendar years that the Forest Project was out of conformance.

3.8.1 Sustainable Harvesting Practices

At the time commercial harvesting is either planned or initiated within the Project Area, the Offset Project Operator or Authorized Project Designee must demonstrate that the Forest Owner(s) employ and demonstrate sustainable long-term harvesting practices on all of its forest landholdings, including the Project Area, using one of the following options:

1. The Forest Owner must be certified 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. The Forest Owner 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.
3. The Forest Owner must employ uneven-aged silvicultural practices (if harvesting occurs) and must maintain canopy cover averaging at least 40 percent across the entire forestland owned by the Forest Owner in the same Assessment Areas covered by the Project Area, as measured on any 20 acres 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).

Forest Owners who acquire new forest landholdings within their entity have up to 5 years to incorporate such acquisitions under their certification or management plan, whether or not such land is contiguous with the Project Area.

3.8.2 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.

Forest Offset Protocol Resources section of ARB's webpage provides required references by Assessment Area for the definition of native forests (see Appendix F). If a state/regional reference is unavailable or inadequate, 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 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. 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.

The following 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 3.8.3.
2. Forest Projects must show verified progress (verified at scheduled site-visits) 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 3.8.4 below.

Forest Projects that initially engage in Natural Forest Management must continue to do so for as long as monitoring and verification of the Forest Project are required by this protocol (i.e. for the duration of the Project Life). 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 still eligible.

The evaluation criteria 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 first verification and at all subsequent verifications. Forest Project carbon stock inventories (requirements for which are contained in Appendix A) 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 carbon 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 verification site visits must demonstrate continuous progress toward goal. This criterion must be met within 25 years.	Project is not in conformance with protocol requirements.	
Composition of Native Species			
Improved Forest Management and Avoided Conversion Projects Where the Project Area naturally consists of a mixed species distribution, no single species'	Species composition is assessed at project initiation 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

prevalence, measured as the 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 'Species Diversity Index' in Forest Offset Protocol Resources section of ARB's website. 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. . **Reforestation** 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 table in Forest Offset Protocol Resources section of ARB's website. 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.	Species composition is assessed at initial verification from inventory data. Project must show continuous progress toward criteria. These criteria must be met within 25 years.	Project is not in conformance with protocol requirements.	Some project sites may not be capable of meeting the requirement. In these cases, a written statement from the government agency in charge of forestry regulation in the state where the project is located must be submitted as described under "Criteria"
Distribution of Age Classes/Sustainable Management			
All forest landholdings owned or controlled by the Forest Owner are currently under one of the following: 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 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 3. The Forest Owner must employ uneven-aged silvicultural practices and canopy retention averaging at least 40 percent across the forest, as measured on any 20 acres within the entire forestland owned by the Forest Owner, including land within and outside of the Project Area. (Areas impacted by Significant Disturbance may be excluded from this test.)	Condition shall be met at all times during project and is assessed during each verification.	Project is not in conformance with protocol requirements.	Applies to all project types at first regeneration harvest
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	Age classes (if even age management is used) are assessed at project initiation and each verification site visit.	NA	

Disturbance may be excluded from this test.)	Project must show continuous progress toward criteria. This criterion must be met within 25 years.	Project is not in conformance with protocol requirements.	
Structural Elements (Standing and Lying Dead Wood)			
Lying dead wood must be retained in sufficient quantities, as described below. **For portions of the Project Area that have not recently undergone salvage harvesting:** 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: ▪ one (1) metric ton of carbon (C) per acre; or ▪ 1% of standing live carbon stocks, in *standing* dead wood, whichever is higher, If a verifier determines that the quantity of lying dead wood is **not** commensurate with recruitment from standing dead 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: ▪ two (2) metric tons of carbon (C) per acre; or ▪ 1% of standing live carbon stocks, in *standing* dead wood, whichever is higher, Standing dead wood 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. **For portions of the Project Area that have undergone salvage harvesting within the previous year:*** 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 wood, 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 wood, Standing dead wood 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. This requirement must be met for a period of 30 years following the salvage harvest. After 30 years, the portion of the Project Area subject to salvage harvesting must meet the requirements for portions	Assessed during project at each verification audit.	Project is not in conformance with protocol requirements.	Applies to all project types throughout the project life

that have not recently undergone salvage harvesting (described above).			

3.8.3 Promotion of the Onsite Standing Live Carbon Stocks

In an effort to promote and maintain the environmental benefits of Forest Projects, the standing live carbon stocks within the Project Area must be maintained and/or increased during the Project Life. Therefore, except as specified below, Offset Credits will not be issued for quantified GHG reductions and removals achieved by a Forest Project if a Forest Project's Offset Project Data Reports – over any 10-year consecutive period – indicate a decrease in the standing live carbon stocks.

Exceptions 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 requirements related to compensating for reversals, as detailed in Section 7.3.

Forest Projects whose standing live carbon stocks have decreased over a 10-year period are not in conformance with protocol requirements, except 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 actions that will be taken to reduce the risks must be documented. 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 management plan that demonstrates harvest levels can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency. In this case, documentation must be 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 carbon stocks, is planned at the initiation of the Forest Project (Figure 3.1). At no time over the Project Life shall the Forest Project's inventory of standing live carbon stocks fall below the Forest Project's baseline 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. Over any consecutive 10-year period, average standing live carbon stocks must be maintained at or above the standing live carbon stocks at the initiation of the project.

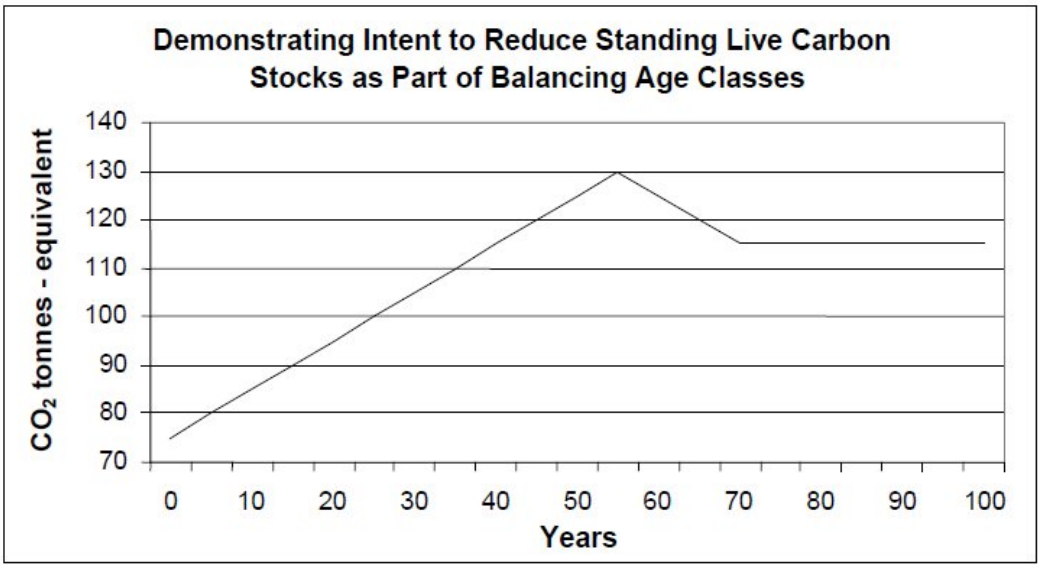


Figure 3.1. Example of Reducing Standing Live Carbon Stocks as Part of Balancing Age Classes

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 during the Project Life shall the Forest Project's inventory of standing live carbon stocks fall below the Forest Project's baseline 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. Over any consecutive 10-year period, average standing live carbon stocks must be maintained at or above the standing live carbon stocks at the initiation of the project. Documentation submitted at the time the Forest Project is Listed 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).

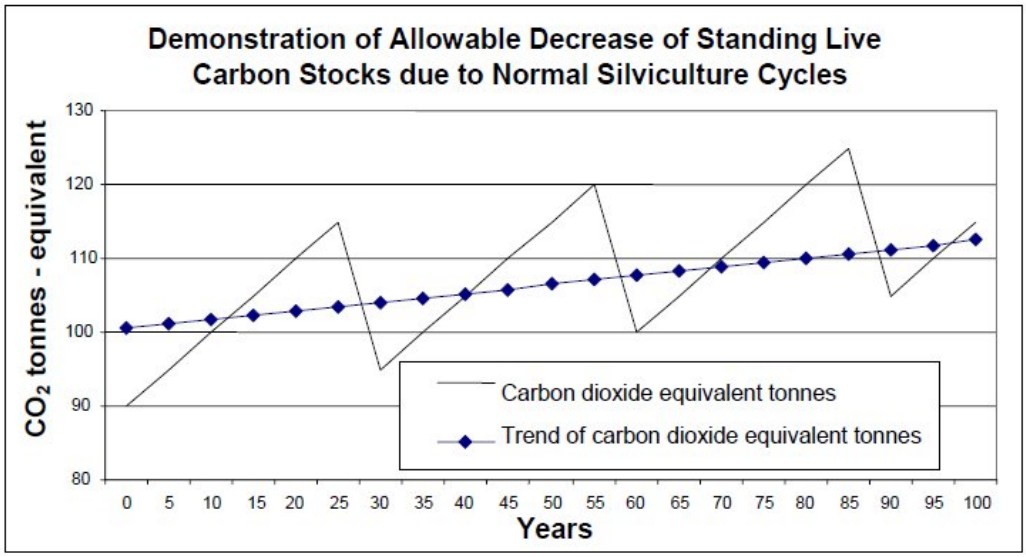


Figure 3.2. Example of Allowable Decrease of Standing Live Carbon Stocks due to Normal Silviculture Cycles

4. The decrease is due to an unintentional reversal such as wildfire, disease, flooding, wind-throw, insect infestation, or landslides.

3.8.4 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 5-years old, or the average height in the adjacent stand is at least 5 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 3.8.3.

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. The boundaries must be defined using a map, or maps, that display public and private roads, major watercourses (4th order or greater), topography, towns, and either public land survey townships, ranges, and sections or latitude and longitude. The maps must be of adequate resolution to clearly identify the required features. 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 Appendix F) 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 10 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 boundary definitions 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 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.
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' 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' of suitable building sites.

5 Offset Project Boundary

The Offset Project Boundary defines all the GHG emission sources, sinks, and reservoirs (SSR's) that must be accounted for in quantifying a Forest Project's GHG reductions and removal enhancements (Section 6). The Offset Project Boundary encompasses all the GHG emission SSR's that may be significantly affected by Forest Project activities, such as forest carbon stocks and harvested wood products. For accounting purposes, the sources, sinks, and reservoirs included in the Offset Project 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). 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 (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 SSRs that may be affected by a Forest Project, and indicate which SSRs must be included in the Offset Project 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. Offset Project Boundary – Reforestation Projects

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method
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 **Project:** Measured by field measurements and updating forest carbon inventory
RF-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
RF-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
RF-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
RF-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method
RF-6	Soil carbon	Reservoir / Pool	CO_2	*Included/excluded: Soil carbon must be included in the Offset Project Boundary if any of the following occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or ▪ Mechanical site preparation activities are not conducted on contours.	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
RF-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes
RF-8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded when project harvesting exceeds baseline Included when project harvesting is below baseline	**Baseline:** Estimated from modeled harvesting volumes **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 **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 **Project:** Estimated using default emission factors
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
RF-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
RF-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A

SSR	Description	Type	Gas	Included or Excluded?	Quantification Method
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
RF-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Included	**Baseline:** N/A **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 **Project:** N/A
RF-15	Combustion emissions from production, transportation, and disposal of forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A -
			N_2O	Excluded	**Baseline:** N/A **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 **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **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) **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 **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A

5.2 Improved Forest Management Projects

Table 5.2. Offset Project Boundary – Improved Forest Management Projects

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
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 **Project:** Measured by field measurements and updating forest carbon inventory
IFM-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
IFM-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
IFM-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
IFM-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Excluded	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
IFM-6	Soil carbon	Reservoir / Pool	CO_2	*Included/ Excluded Soil carbon must be included in the Offset Project Boundary, if any of the following activities occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or ▪ Mechanical site preparation activities are not conducted on contours.	**Baseline:** Modeled based on initial field inventory measurements **Project:** Measured by updating forest carbon inventory
IFM-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes
IFM-8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded when project harvesting exceeds baseline Included when project harvesting is below baseline	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes
Secondary Effect Sources, Sinks, and Reservoirs					
IFM-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	**Baseline:** N/A **Project:** Quantified based on measured carbon stock changes in included reservoirs (SSR #IFM-6, where applicable)

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
				changes in included carbon reservoirs	
IFM-10	Mobile combustion emissions from site preparation activities	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
IFM-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A .
IFM-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
IFM-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Excluded	**Baseline:** N/A **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 **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 **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
IFM-16	Combustion emissions from	Source	CO_2	Excluded	**Baseline:** N/A

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
	production, transportation, and disposal of alternative materials to forest products				**Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **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) **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 **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A

5.3 Avoided Conversion Projects

Table 5.3. Offset Project Boundary – Avoided Conversion Projects

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
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 **Project:** Measured by field measurements and updating forest carbon inventory
AC-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
AC-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	**Baseline:** Modeled based on initial field inventory measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory
AC-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
AC-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
AC-6	Soil carbon	Reservoir	CO_2	*Included/ Excluded	**Baseline:** Modeled based on initial field inventory

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
		/ Pool		Soil carbon must be included in the Offset Project Boundary, if any of the following activities occur: ▪ Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or Mechanical site preparation activities are not conducted on contours.	measurements and expected land-use conversion rates **Project:** Measured by updating forest carbon inventory
AC-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Included	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes
AC-8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded when project harvesting exceeds baseline Included when project harvesting is below baseline	**Baseline:** Estimated from modeled harvesting volumes **Project:** Estimated from measured harvesting volumes
Secondary Effect Sources, Sinks, and Reservoirs					
AC-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 **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 **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
AC-11	Mobile combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
AC-12	Stationary combustion emissions from ongoing project operation & maintenance	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A

SSR	Description	Type*	Gas	Included or Excluded?	Quantification Method
					Project: N/A
AC-13	Biological emissions from clearing of forestland outside the Project Area	Source	CO_2	Included	**Baseline:** N/A **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 **Project:** N/A
AC-15	Combustion emissions from production, transportation, and disposal of forest products	Source	CO_2	Excluded	**Baseline:** N/A **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **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 **Project:** N/A
			CH_4	Excluded	**Baseline:** N/A **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **Project:** N/A
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) **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 **Project:** N/A
			N_2O	Excluded	**Baseline:** N/A **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 methods for quantifying a Forest Project's net GHG reductions and removals.

Quantification Methodology:
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 carbon stock changes in each of the Forest Project's required onsite carbon pools (identified in Sections 5.1 to 5.3) must be modeled over 100 years. Modeling must be based on inventoried carbon stocks at the time of the Forest Project's commencement (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 in Appendix A; modeling of onsite carbon stocks over time must be conducted following the requirements in this section and the requirements and methods in Appendix B. Baseline onsite carbon stocks are estimated over 100 years at the time of the project's initiation.
2. **Estimating baseline carbon in harvested wood products.** In conjunction with modeling baseline onsite carbon stocks, a forecast of any harvesting that would have occurred in the baseline must be developed and converted to an average annual harvesting volume. From this, the amount of carbon that would have been transferred each year (on average) to long-term storage in wood products can be determined. Baseline harvesting is forecasted following the requirements in this section and carbon stored in wood products must be calculated following the requirements and methods in Appendix C.
3. **Determining actual onsite carbon stocks.** Each year, the Forest Project's actual onsite carbon stocks must be determined. This must be done by updating the Forest Project's forest carbon inventory for the current year, following the requirements and methods in this section and in Appendices A and B. The estimate of actual onsite carbon stocks must be adjusted by an appropriate confidence deduction, as described in Appendix A, Section A.4.
4. **Determining actual carbon in harvested wood products.** Each year, any harvesting in the Project Area must be reported and from this, the amount of carbon transferred to long-term storage in wood products must be calculated following the requirements and methods in Appendix C.
5. **Calculating the project's Primary Effect.** Each year, the actual change in GHG emissions or removals associated with the Forest Project's intended ("Primary") effect must be quantified, 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
    b. Subtracting from (a) the difference between baseline onsite carbon stocks for the current year and baseline onsite carbon stocks for the prior year
    c. Adding to (b) the calculated difference between actual and baseline carbon in harvested wood products for the current year (see Equation 6.1.)

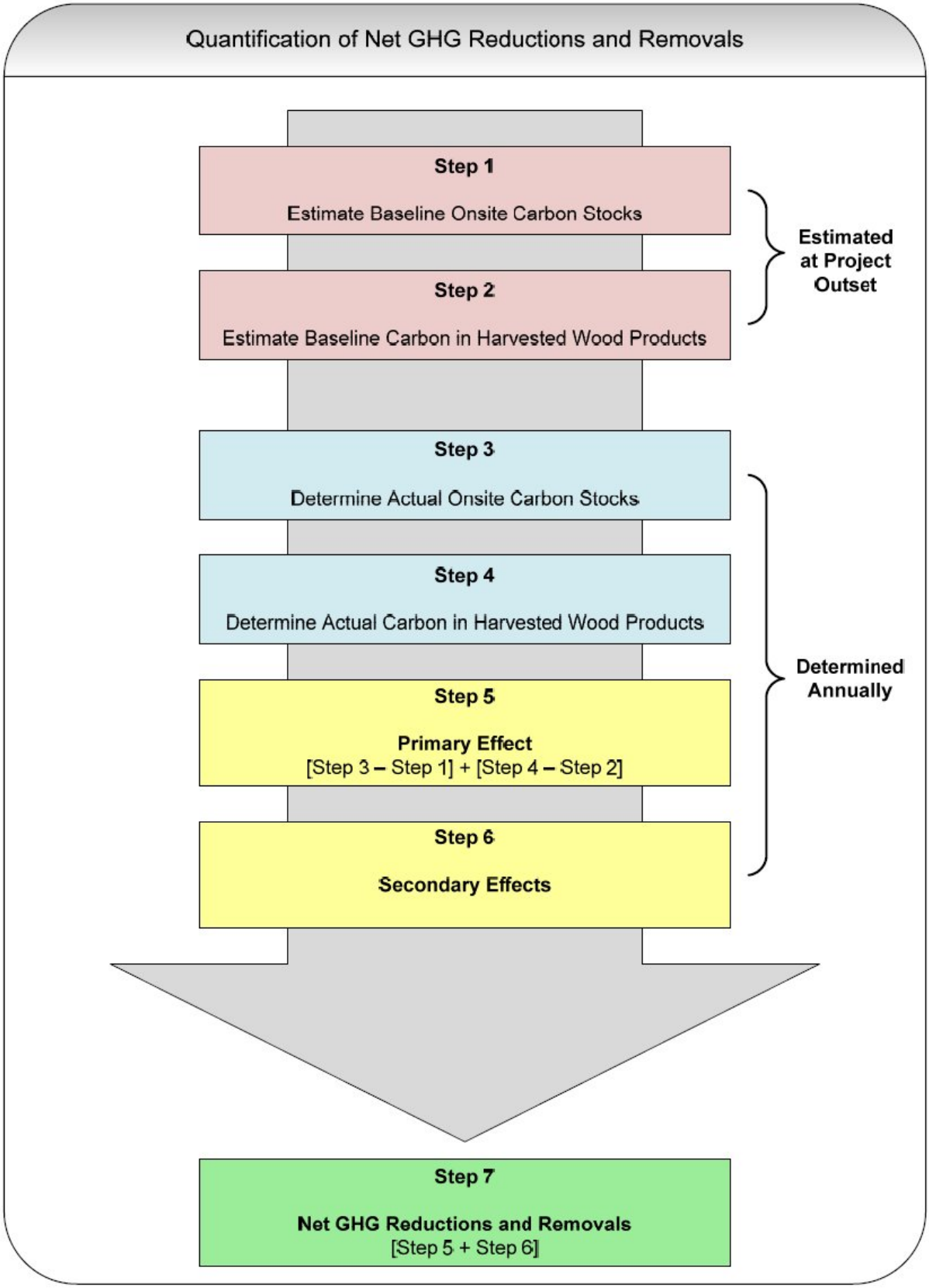
6. **Quantifying the project's Secondary Effects.** Each year, the actual change in GHG emissions or removals associated with the Forest Project's unintended ("Secondary")

effects must be quantified as defined in Section 5. Requirements and methods 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 indicates a reversal has occurred except as specified below (see Section 7).

Requirements 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.

A reversal occurs only if: (1) total net GHG reductions and removals for the year are negative; and (2) Offset Credits have previously been issued to the Forest Project. If calculated GHG reductions and removals are negative and no Offset Credits have been issued to the project since its commencement 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]

Quantification Methodology

Equation 6.1.

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

Where,

QR_y = Quantified GHG reductions and removals for year y

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

Where,

$AC_{onsite,\,y}$ = Actual onsite carbon (CO_2e) as inventoried for year y

$AC_{onsite,\,y-1}$ = Actual onsite carbon (CO_2e) as inventoried for year y-1 (if y is the first year of the project, then the value for $AC_{onsite,\,y-1}$ will be zero)

CD_y = Appropriate confidence deduction for year y, as determined in Appendix A, Section A.4.

CD_{y-1} = Appropriate confidence deduction for year y-1, as determined in Appendix A, Section A.4.

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

Where,

$BC_{onsite,\,y}$ = Baseline onsite carbon (CO_2e) as estimated for year y

$BC_{onsite,\,y-1}$ = Baseline onsite carbon (CO_2e) as estimated for year y-1 (if y is the first year of the project, then the value for $BC_{onsite,\,y-1}$ will be zero) [5]

$AC_{wp,\,y}$ = 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 requirements and methods in Appendix C)

$BC_{wp,y}$ = 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)

SE_y = Secondary Effect GHG emissions caused by the project activity in year y

ACD = Avoided Conversion Project discount factor, determined in Section 6.3.1

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)

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 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 (see Section 6.2.6).

[5] For Improved Forest Management projects, where baseline onsite carbon stocks are averaged across all years, the value for ΔBC_{onsite} will be zero in all years except the first year of the project.

6.1 Reforestation Projects

6.1.1 Estimating Baseline Onsite Carbon Stocks

Quantification Methodology

To estimate baseline carbon stocks for a Reforestation Project:

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 the carbon stocks in each of the project's required carbon pools, following the requirements in Appendix A of this protocol.[6] 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 using one of the following alternatives:
    - 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.
    - Stratifying (classifying) the Project Area into similar densities and measuring stocks within the affected carbon pools using 20 sample plots per density class.
    - Measuring the affected carbon stocks based on a grid system across the Project Area.

For other carbon stocks, the inventory may be deferred, as described below.

3. Once a full inventory is obtained, perform a computer simulation that models the carbon stocks for 100 years following the forest project's commencement date, based on the qualitative characterization of what would have occurred without the project. The modeling must follow the requirements and methods for modeling contained in Appendix B, Section B.3, 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 verification. At the time of the second verification, an estimated inventory of the all required carbon stocks at the time of the Forest Project's commencement date must prepared by:

1. Assuming standing dead carbon stocks at the time of the Forest Projects' commencement date were equal to the standing dead carbon stocks measured and verified at the second verification.
2. Using an approved growth model or a stand table projection methodology, as described in Appendix B, Section B.1, 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

[6] Initial carbon stocks could be zero if the Project Area has no quantifiable forest cover or required carbon pools.

Forest Project's 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.

If the inventory of these carbon pools is deferred, 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 Offset Credits until after the second verification.

6.1.2 Estimating Baseline Carbon in Harvested Wood Products

Quantification Methodology

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 Appendix B) 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 project commencement using the same biomass equations used to calculate biomass in live trees, and will not change over the course of the project crediting period.
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 and methods in Appendix C.

6.1.3 Determining Actual Onsite Carbon Stocks

Quantification Methodology

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 and requirements and methods for projecting forest inventory plot data using models is provided in Appendix B.
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 requirements and methods in Appendix A, Section A.4.

6.1.4 Determining Actual Carbon in Harvested Wood Products

Quantification Methodology

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 and methods in Appendix C.

6.1.5 Quantifying Secondary Effects

Quantification Methodology

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

1. One-time combustion emissions associated with machinery use 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), which is accounted for over the Project Life.

To quantify combustion emissions associated with site preparation, use the appropriate standard emission factor from Table 6.1 corresponding to the level of brush cover on the Project Area, multiplied by the number of acres in the Project Area (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

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

Where,

MC_y = Secondary Effect CO_2e emissions due to mobile combustion from site preparation

EF_{mc} = Mobile combustion emission factor from Table 6.1

PA = The size of the Project Area, in acres

Table 6.1. Mobile Combustion Emissions for Reforestation Projects

SITE PREP - REFORESTATION PROJECTS		
Emissions Associated with Mobile Combustion		
Average Metric Tons CO_2e 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, determine the appropriate “leakage” risk percentage for the project following the decision tree in Figure 6.3. The leakage risk percentage is only determined once, at project commencement. 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,

AS_y = Secondary Effect CO_2e emissions due to shifting of cropland or grazing activities

L = Leakage risk percentage, as determined from Figure 6.3

ΔAC_{onsite} = Annual difference in actual onsite carbon (CO_2e) as defined in Equation 6.1.

ΔBC_{onsite} = Annual difference in baseline onsite carbon (CO_2e) as defined in Equation 6.1.

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

$SE_y = (AS_y + MC_y)$ *or* **0**, whichever is lower

Where,

SE_y = Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1)

AS_y = Secondary Effect CO_2e emissions due to shifting of cropland or grazing activities

MC_y = Secondary Effect CO_2e emissions due to mobile combustion from site preparation*

*only occurs in year 1.

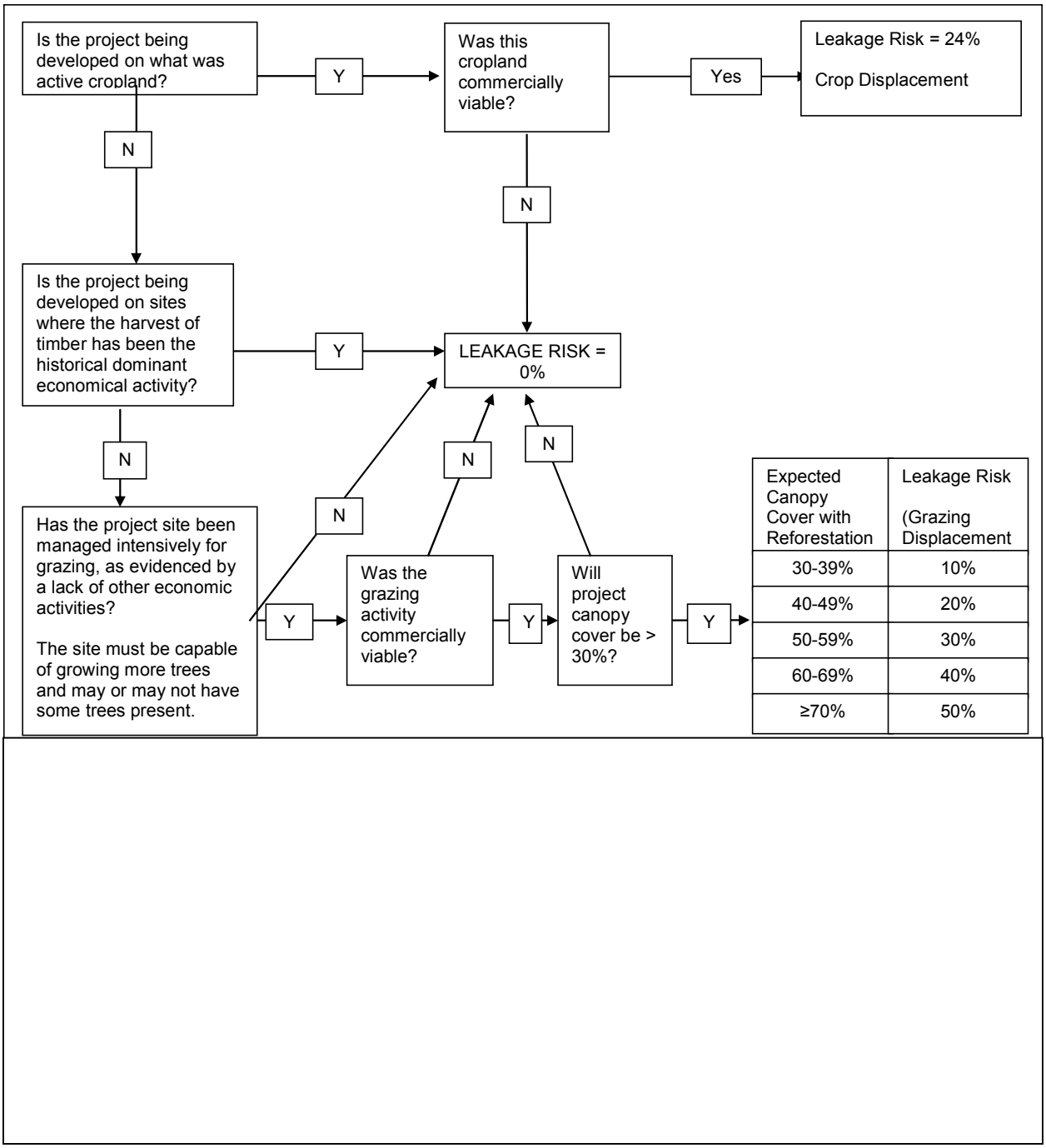


Figure 6.3. Activity Shifting ("Leakage") Risk Assessment for Reforestation Projects

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 offset project commencement 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

Quantification Methodology

The baseline approach for Improved Forest Management Projects on private lands applies a standardized set of assumptions to project-specific conditions. A key assumption is that baseline carbon stocks will depend on how a project's initial standing live carbon stocks compare to "Common Practice," defined as the average standing live carbon stocks on similar lands within the project's Assessment Area. In addition, baseline carbon stocks must be adjusted to reflect management practice on the Forest Owner's other landholdings in instances where Project Area carbon stocks are more than 20 percent below the carbon stocks on land within the same logical management unit. Finally, the baseline must be modeled to reflect all legal and economic constraints affecting the Project Area.

The following steps must be followed to estimate baseline carbon stocks:

1. Determine the Common Practice level of above-ground standing live carbon stocks applicable to the Project Area.
2. Determine if the Project Area's initial above-ground standing live carbon stocks are above or below Common Practice.
3. Estimate baseline above-ground standing live carbon stocks, taking into account financial and legal constraints on harvesting in the Project Area, as well as the minimum baseline level applicable to the Project Area, as defined in the requirements for Step 3, below. The minimum baseline level will depend on whether initial above-ground standing live carbon stocks are above or below Common Practice.
4. Determine the baseline carbon stocks over 100 years for all required carbon pools in the Project Area.

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

Step 1 – Determine the Common Practice Carbon Stocks for the Project's Assessment Area

As defined in this protocol, 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 is used as a reference point for baseline estimation. To determine a value for Common Practice, see Appendix F and the data available in the Forest Offset Protocol Resources section of ARB's website.

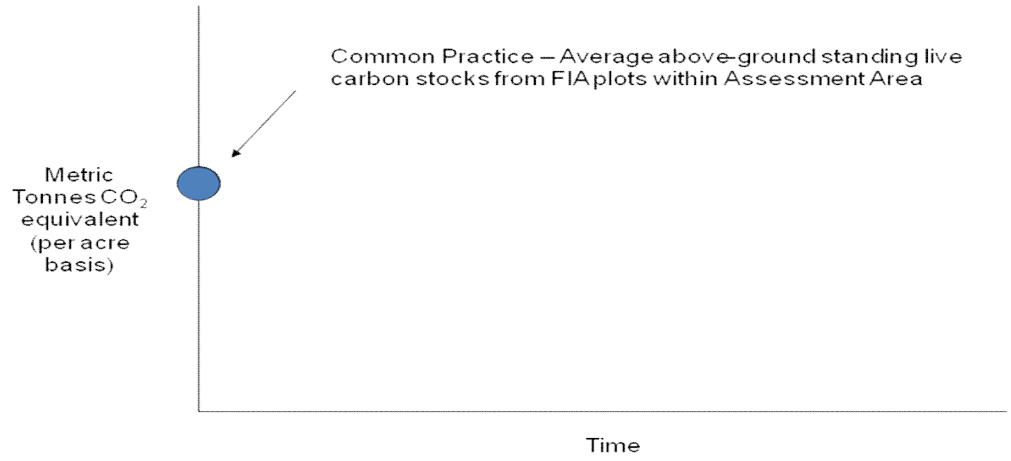


Figure 6.4. Common Practice as a Reference Point for Baseline Estimation

Step 2 – Determine if Initial Above-Ground Standing Live Carbon Stocks Are Above or Below Common Practice

To determine if initial above-ground standing live carbon stocks are above or below Common Practice, perform the following steps:

1. From the initial forest carbon inventory for the Project Area (conducted following the requirements in Appendix A), identify the metric tons of carbon contained in the *above-ground portion* of standing live carbon stocks.
2. Divide this amount by the number of acres in the Project Area.
3. Compare the result with the Common Practice value identified in Step 1.

Step 3 – Determine Baseline Above-Ground Standing Live Carbon Stocks

The baseline above-ground standing live carbon stocks must be determined by: (1) Modeling above-ground standing live carbon stocks through a series of growth and harvesting scenarios over 100 years; and (2) averaging the model results over the 100-year timeframe, so that the baseline is expressed as a single (average) value for above-ground standing live carbon stocks per acre in every year. The modeling must be performed following the requirements and methods in Appendix B and must meet the following conditions:

1. Growth and harvesting scenarios must reflect all legal constraints, following the requirements in Section 6.2.1.2.
2. Growth and harvesting scenarios must reflect any financial constraints, following the requirements in Section 6.2.1.3.
3. The averaged model results, expressed as above-ground standing live carbon stocks per acre, must not fall below a minimum baseline level (MBL). If initial above-ground standing live carbon stocks are above Common Practice, the MBL must be determined using the formula in Equation 6.5. If initial above-ground standing live carbon stocks are below Common Practice, then MBL must be determined using the formula in Equation 6.6.

A graphical example of a baseline meeting these conditions is provided in Figure 6.5 and Figure **6.6**. Figure 6.5 shows the baseline before averaging; Figure 6.6 shows the baseline after averaging.

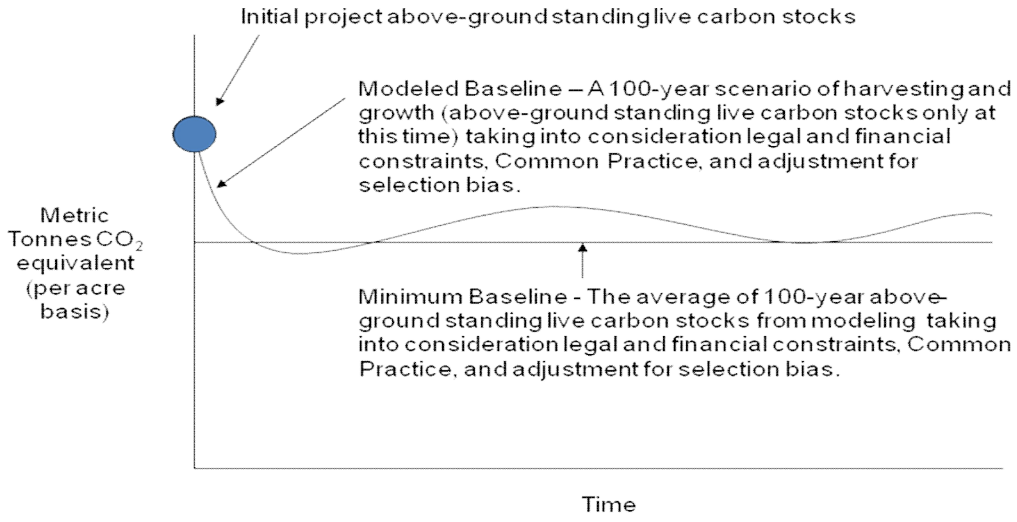


Figure 6.5. Modeling Standing Live Carbon Stocks Where Initial Stocks Are Above Common Practice

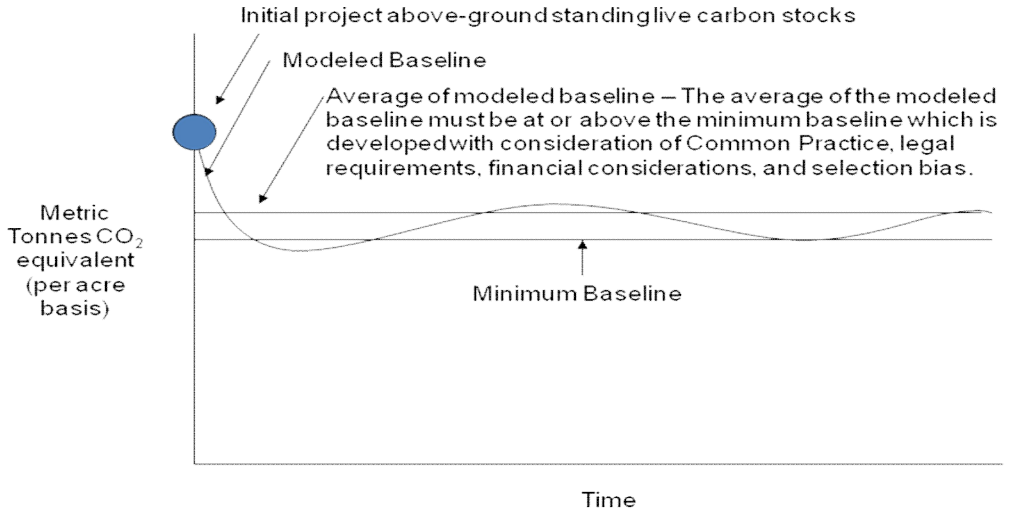


Figure 6.6. Averaging the Modeled Standing Live Carbon Stocks Where Initial Stocks Are Above Common Practice

Equation 6.5. Determining the Minimum Baseline Level Where Initial Stocks Are Above Common Practice

MBL = CP

Where,

MBL = Minimum baseline level (above-ground standing live carbon stocks)

CP = Common Practice (as determined in Step 1)

Equation 6.6. Determining the Minimum Baseline Level Where Initial Stocks Are Below Common Practice

MBL = MAX (MAX (HSR, ICS), MIN (CP, WCS))

Where,

MBL = Minimum baseline level (above-ground standing live carbon stocks)

HSR = The "High Stocking Reference" for the Project Area. 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 Offset Project Operator or Authorized Project Designee 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 Forest Owner has had control of the stocks, whichever is shorter. Figure 6.7 presents a graphical portrayal of a High Stocking Reference determination.

CP = Common Practice (as determined in Step 1)

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area (as determined in Step 2)

WCS = The weighted average above-ground standing live carbon stocks per acre for all Forest Owner (and affiliate) landholdings within the same logical management unit as the Project Area. See Section 6.2.1.1 for requirements and methods for calculating WCS.

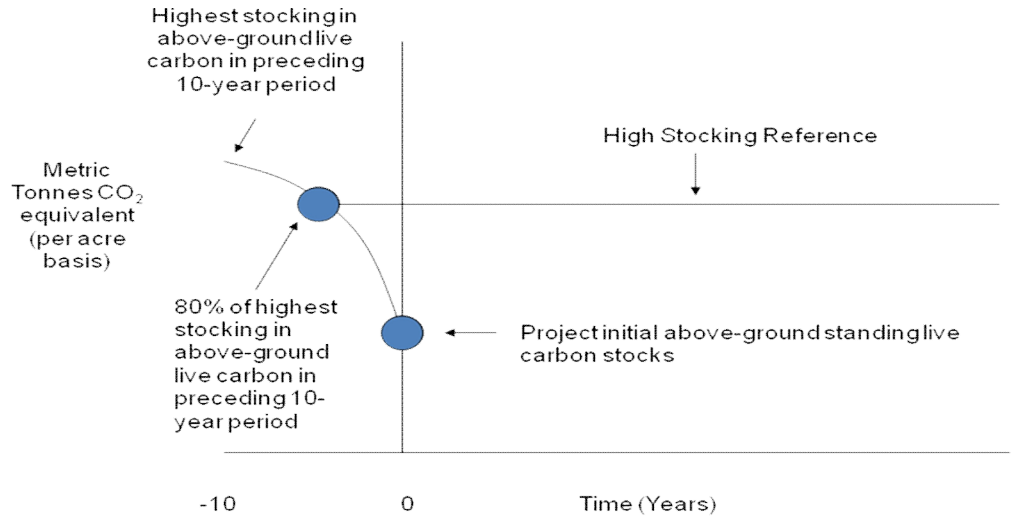


Figure 6.7. Determining a Project Area's High Stocking Reference

* 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.

Step 4 – Determine the Baseline for All Carbon Pools

Once the baseline for above-ground standing live carbon stocks has been determined, perform the following steps:

1. Estimate baseline carbon stocks for all other required carbon pools identified for the project (including below-ground carbon stocks, as well as standing dead carbon stocks where applicable). These carbon stocks must be modeled or estimated following the requirements and methods in Appendix A and Appendix B.
2. Average the results, so that the baseline for other carbon pools contains the same (average) value for carbon stocks in every year.
3. Sum the above-ground standing live carbon stock baseline and the baseline for all other carbon stocks to produce a final baseline for all carbon pools (see Figure 6.8).

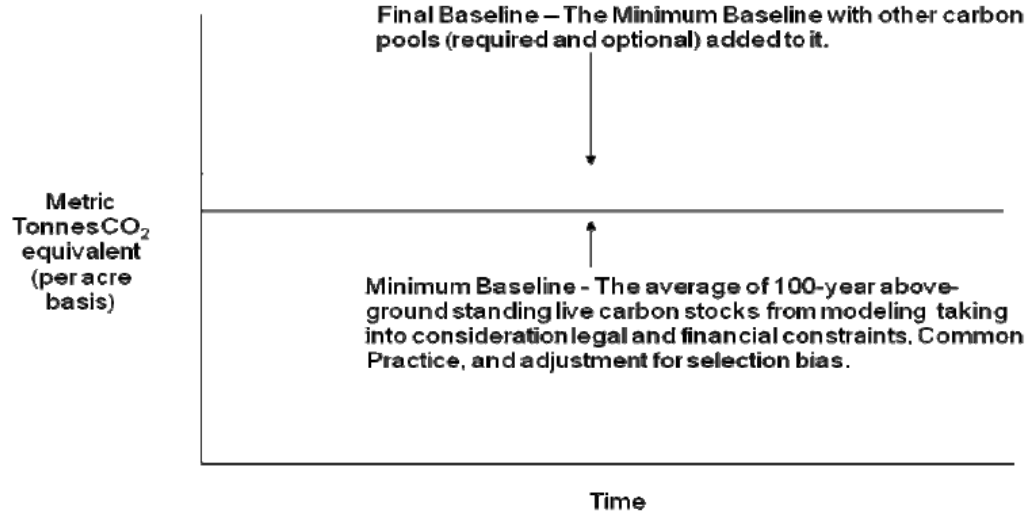


Figure 6.8. Final Baseline Incorporating All Required Carbon Stocks

6.2.1.1 Determining Weighted Average Carbon Stocks (WCS) on Lands in the Same Logical Management Unit as the Project Area

Quantification Methodology
Determining the minimum baseline level (MBL) for an Improved Forest Management project requires a comparison to carbon stocking levels on other lands within the same logical management unit (LMU) as the Project Area. The carbon stocking level within the LMU (expressed as the weighted average above-ground standing live carbon stocks per acre for all lands in the same LMU) is used as a parameter (WCS) for determining the MBL in Equation 6.6.

A “logical management unit” or “LMU” is defined as all land that the Forest Owner and its affiliate(s) (as defined below) either own in fee or hold timber rights on, and which it or they manage as an explicitly defined planning subunit. LMUs are generally characterized by unique biological, geographical, and/or geological conditions, are generally delimited by watershed boundaries and/or elevational zones, and contain 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.
- Where even aged management is utilized, have a uniform distribution (by area) of 10-year age classes that extend to the normal rotation age (variation of any 10-year age class not to exceed 20%).
- Where uneven aged management is utilized, have between 33% and 66% of the forested stands exceeding the retention standards identified in the growth and harvest projections by a minimum of 25% (basal area).

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, 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.

If an explicit, existing LMU containing the Project Area cannot be identified, the LMU must be defined by identifying all lands where the Forest Owner and its affiliate(s) (as defined above) either own in fee or hold timber rights on within the same Assessment Area(s) covered by the Project Area. Assessment Areas covered by the Project Area are identified in Step 1, above, using the information in Appendix F.

To calculate WCS, 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.

6.2.1.1.1 Calculating WCS Using Inventory Data

Quantification Methodology

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 6.7 must be used to calculate WCS.

Equation 6.7. 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 carbon stocks per acre within the LMU containing the Project Area

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area

PA = Size of the Project Area in 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

EA = Size of the LMU in acres, e*xcluding the Project Area*

6.2.1.1.2 Calculating WCS Using Stratified Vegetation-Type Analysis

Quantification Methodology

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 6.2 with a resolution for classification no greater than 40 acres. Each vegetation class has a "carbon rating" provided 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 6.8 and Equation 6.9.

Equation 6.8. Formula for WCS Using Stratified Vegetation-Type Analysis

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

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

Where,

WCS = The weighted average above-ground standing live carbon stocks per acre within the LMU containing the Project Area

ICS = Initial above-ground standing live carbon stocks per acre within the Project Area

PA = Size of the Project Area in acres

SWF = The stratified carbon weighting factor for the LMU (from Equation 6.9 below)

EA = Size of the LMU in acres, e*xcluding the Project Area*

Equation 6.9. Formula for LMU Stratified Carbon Weighting Factor

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

Where,

PA_i = Acres of the Project Area in forest vegetation type *i* (from Table 6.2)

EA_i = Acres of the LMU, e*xcluding the Project Area,* in forest vegetation type *i* (from Table 6.2)

CR_i = Carbon rating for forest vegetation type *i* (from Table 6.2)

Table 6.2. Vegetation Classes for Stratification

Forest Vegetation Description	Average Diameter (Breast Height)	Average Canopy Cover	Carbon Rating (metric tons 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

6.2.1.2 Consideration of Legal Constraints

In modeling the baseline for standing live carbon stocks, all legal constraints that could affect baseline growth and harvesting scenarios must be incorporated. The standing live carbon stock 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 offset project's commencement 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 offset project commencement that could affect standing live 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, Habitat Conservation Plans, Safe Harbor Agreements, 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 3.5.

For forest projects located in California, the 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 in identifying minimum carbon stocking levels that would be effectively required under California Forest Practice Rules.

6.2.1.3 Consideration of Financial Constraints

In modeling the baseline for standing live carbon stocks, financial constraints that could affect baseline growth and harvesting scenarios must be included. It must be demonstrated that the growth and harvesting regime assumed for the 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 10 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)

6.2.2 Estimating Baseline Onsite Carbon Stocks – Public Lands

Quantification Methodology

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 requirements and methods in Appendix B incorporating constraints imposed by all applicable statutes, regulations, policies, plans and Activity-Based Funding.

6.2.3 Estimating Baseline Carbon in Harvested Wood Products

Quantification Methodology

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 and methods in Appendix C.

6.2.4 Determining Actual Onsite Carbon Stocks

Quantification Methodology

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 to "grow" (project forward) prior-year data from existing forest inventory plots to the current reporting year. Approved growth models and requirements and methods for projecting forest inventory plot data using models is provided in Appendix B.
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 requirements and methods in Appendix A, Section A.4.

6.2.5 Determining Actual Carbon in Harvested Wood Products

Quantification Methodology

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 and methods in Appendix C.

6.2.6 Quantifying Secondary Effects

Quantification Methodology

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. Equation 6.10 must be used to estimate Secondary Effects for Improved Forest Management projects:

Equation 6.10. 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,

SE_y	=	Estimated annual Secondary Effects (used in Equation 6.1.)
$AC_{hv,\,n}$	=	Actual amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons
$BC_{hv,\,n}$	=	Estimated average baseline amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons, as determined in Step 1 of Section 6.2.3
y	=	The current year or reporting period

6.3 Avoided Conversion Projects

6.3.1 Estimating Baseline Onsite Carbon Stocks

Quantification Methodology

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 the baseline
2. Discount for the uncertainty of conversion probability

Step 1 - Characterizing and Projecting the Baseline

The project the 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 Section 3.1.2.3).
2. Estimating the rate of conversion and 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 6.3.
3. Using a computer simulation to project changes in onsite carbon stocks over 100 years, reflecting the rate of conversion estimated in (2). The simulation must model changes in onsite carbon stocks for all required and selected optional carbon pools, as identified in Section 5.3.

Table 6.3. Default Avoided Conversion

Type of Conversion Identified in Appraisal	Total Conversion Impact 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 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: TC = min(100, (P*3 / PA)*100) *Where:* TC = % total conversion (TC cannot exceed 100%) PA = the Project Area (acres) identified in the appraisal P = the number of unique parcels that would be formed on the project area as	Estimate using the following formula: AC = TC / 10 *Where:* AC = % annualized conversion TC = % total conversion

	identified in the appraisal *Each parcel is assumed to deforest 3 acres of forest vegetation.	
Mining and agricultural conversion, including pasture or crops	90%	9.0%
Golf course	80%	8.0%
Commercial buildings	95%	9.5%

The computer simulation of the baseline must apply the identified rate of conversion over time to estimate changes in onsite carbon stocks, beginning with the Project Area's initial onsite carbon stocks.

If the projected conversion rate does not result in a complete removal of onsite forest carbon stocks, the baseline projection should account for any residual forest carbon value as a steady condition for the balance of a 100-year projection.

Step 2 - Discount for Uncertainty of Conversion Probability

If the fair market value of the anticipated alternative land use for the Project Area (as determined by the appraisal required in Section 3.1.2.3) is *not more than 80 percent greater* than the value of the current forested land use, then a discount must be applied each year to the project's quantified GHG reductions and removals. If quantified GHG reductions and removals for the year are positive (i.e. $[(\Delta AC_{onsite} - \Delta BC_{onsite}) + (AC_{wp,\,y} - BC_{wp,\,y}) * 80\% + SE_y] > 0$ in Equation 6.1) then use the following formula (Equation 6.11) to calculate the appropriate Avoided Conversion Discount factor, ACD. If quantified GHG reductions and removals for the year are negative, then ACD must equal zero.

Equation 6.11. Avoided Conversion Discount Factor

If $0.4 < ((VA / VP) - 1) < 0.8$, **then** $ACD = [80\% - ((VA / VP) - 1)] \times 2.5$
If $((VA / VP) - 1) > 0.8$, **then** $ACD = 0\%$
If $((VA / VP) - 1) < 0.4$, **then** $ACD = 100\%$

Where,

ACD = The Avoided Conversion Project discount factor (used in Equation 6.1).

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

6.3.2 Estimating Baseline Carbon in Harvested Wood Products

Quantification Methodology

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. 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 and methods in Appendix C.

6.3.3 Determining Actual Onsite Carbon Stocks

Quantification Methodology

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 Appendix B. Methods for projecting forest inventory plot data using models is also provided in Appendix B.
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 requirements and methods in Appendix A, Section A.4.

6.3.4 Determining Actual Carbon in Harvested Wood Products

Quantification Methodology

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 6.3.3).
2. Determine the amount of actual harvested carbon that will remain stored in wood products, averaged over 100 years, following the requirements and methods in Appendix C.

6.3.5 Quantifying Secondary Effects

Quantification Methodology

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, use Equation 6.12.

The value for Secondary Effect emissions will always be negative or zero.

Equation 6.12. Secondary Effects Emissions

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

Where,

SE_y	=	Secondary Effect GHG emissions caused by the project activity in year y (Equation 6.1)
CDR	=	Conversion displacement risk value, assumed to be 3.6% for all forest lands
$\Delta\ AC_{onsite}$	=	Annual difference in actual onsite carbon (CO_2e) as defined in Equation 6.1
$\Delta\ BC_{onsite}$	=	Annual difference in baseline onsite carbon (CO_2e) as defined in Equation 6.1

7 Ensuring the Permanence of Credited GHG Reductions and Removals

The Cap and Trade Regulation requires that credited GHG reductions and removals be "permanent." Permanence of Forest project GHG reductions and removals is addressed through three mechanisms:

1. The requirement for all 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.
2. The regulatory obligation for all intentional reversals of GHG reductions and removals be compensated for through retirement of other Compliance Instruments .
3. The maintenance of a Forest Buffer Account by ARB to provide insurance against reversals of GHG reductions and removals due to unintentional 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 may therefore result in an unintentional reversal, 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 intentional as defined in the Regulation. The Offset Project Operator or Authorized Project Designee is 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 Offset Credits that the project must contribute to the Forest Buffer Account to insure against unintentional reversals.

7.1 Identifying a Reversal

The Offset Project Operator or Authorized Project Designee must demonstrate, through annual reporting and periodic verification, that stocks associated with credited GHG reductions and removals are maintained for a period of time considered to be permanent. For purposes of this protocol 100 years is considered permanent. If the quantified GHG reductions and removals (i.e. QR_y in Equation 6.1) in a given year are negative, and Offset Credits were issued to the Forest Project in any previous year, it is considered 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

Unintentional reversals are insured against by contributing a percentage of ARB-issued Offset Credits to a Forest Buffer Account. The amount of the contribution is based on a project-specific risk evaluation.

7.2.1 About the Forest Buffer Account

A Forest Buffer Account is a holding account for Offset Credits issued to Forest Project, which is administered by ARB. All Forest Projects must contribute a percentage of Offset Credits to the Buffer Account any time Offset Credits are issued by ARB 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 unintentional reversal of credited GHG reductions and removals (as defined in Section 7.3), 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_2-equivalent) according to the process identified in the Regulation and Section 7 of this protocol. A Forest Buffer Account therefore acts as a general insurance mechanism against unintentional reversals for Offset Credits issued to Forest Projects.

7.2.2 Contributions to the Forest Buffer Account

Each time Offset Credits are issued by ARB for verified GHG reductions and removals achieved by a Forest Project, a certain percentage of those Offset Credits must be contributed to a Forest Buffer Account. The size of the contribution to the Forest Buffer Account will depend on the Forest Project's risk rating for reversals. For example, if a Forest Project is issued 10 Offset Credits after verification, and the project's reversal risk rating is 10 percent, then 9 Offset Credits will be issued to the Offset Project Operator or Authorized Project Designee, and 1 Offset Credit must be deposited in the Forest Buffer Account.

The Offset Project Operator or Authorized Project Designee must determine the reversal risk rating for a project by following the requirements and methods in Appendix D. The risk rating must be determined prior to listing, and recalculated in every year the project undergoes verification. Forest Owners who record a Qualified Conservation Easement in conjunction with implementing a Forest Project will receive a lower risk rating (see Appendix D).

7.3 Compensating for Reversals

ARB requires that all reversals be compensated through the retirement of Compliance Instruments. If a reversal associated with a Forest Project is found to have been unintentional as defined in the Regulation, then ARB will compensate for the reversal on the behalf of the Offset Project Operator or Authorized Project Designee by retiring Offset Credits from the Forest Buffer Account. If a reversal is found to be intentional as defined in the Regulation, then the Offset Project Operator or Authorized Project Designee must compensate for the reversal by surrendering Compliance Instruments from its own account.

7.3.1 Unintentional Reversals

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

1. If there has been an Unintentional Reversal, the Offset Project Operator or Authorized Project Designee must notify ARB or the approved offset registry where the project is listed in writing of the Unintentional Reversal within six months of its occurrence.
2. The Offset Project Operator or Authorized Project Designee must explain the nature of the Unintentional 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 ARB determines that there has been an Unintentional Reversal, it will retire a quantity of Offset Credits from the Forest Buffer Account equal to the quantity of the reversed carbon in CO_2-equivalent metric tons.

7.3.2 Intentional Reversals

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

1. If an Intentional Reversal has occurred, written notice must be provided to ARB within thirty days calendar days. Additionally, if ARB or an approved Offset Project Registry determines that an Intentional Reversal has occurred, it shall deliver written notice to the Offset Project Operator or Authorized Project Designee.
2. Within thirty days of ARB receiving the intentional reversal notice, the Offset Project Operator or Authorized Project Designee must provide a written description and explanation of the reversal to ARB.
3. Within three months of ARB receiving the intentional reversal notice, the Offset Project Operator or Authorized Project Designee must provide ARB with a verified estimate of current onsite carbon stocks;
4. Within four months of ARB receiving the intentional reversal notice, the Offset Project Operator or Authorized Project Designee must retire a quantity of Compliance Instruments equal to the quantity of the reversed carbon in CO_2-equivalent metric tons.

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. In this circumstance, the original approved baseline for the project would no longer be valid. If the Forest Project is automatically terminated due to an Unintentional Reversal, another project may be initiated on the same Project Area. New projects may not be initiated on the same Project Area if a Forest Project is terminated due to an Intentional Reversal.

If a 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 Forest Buffer Account in future years based on its verified risk rating.

8 Project Monitoring

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. The Offset Project Operator or Authorized Project Designee must conduct monitoring activities and submit Offset Project Data Reports on an annual basis. Monitoring is required for a period of 100 years following the final issuance of any Offset Credits to a project.

For Forest Projects, monitoring activities consist primarily of updating a project's forest carbon inventory. ARB requires a complete inventory of carbon stocks to be reported each year. This complete inventory must be maintained and updated throughout the Project Life.

8.1 Forest Carbon Inventory Program

Prior to a Forest Project's first verification, a documented forest carbon inventory program, including an inventory monitoring plan and a modeling plan, must be established detailing the specific methods that will be used to update the project's forest carbon inventory on an annual basis. The forest carbon inventory program must adhere to the requirements and methods in Appendices A and B, which establish the equations for computing biomass and limits to which computer models can be used in the inventory update process.

8.2 Annual Monitoring Requirements

The Offset Project Operator or Authorized Project Designee is required to report the Forest Project's onsite carbon stocks each year in an Offset Project Data Report. The offset project data report must include an estimate of carbon stocks in all required carbon pools. The estimate must reflect the appropriate confidence deduction as determined by the steps in Appendix A, Section A.4. Annual onsite carbon stock estimates are computed from inventory data. Inventory data are updated annually by:

1. Incorporating any new forest inventory data obtained during the previous year.
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).
3. Updating the forest inventory data for harvests and/or disturbances that have occurred during the previous year.

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 be approved in advance by a third-party verification body and by ARB, and documented in the change log.

9 Reporting Requirements

This section provides requirements for reporting. Offset Project Data Reports must be submitted at the conclusion of every project reporting period.

9.1 Project Documentation

In order for the project to be Listed, all of the information specified in the Project Listing Requirements in Section 9.1.1 must be submitted, along with any additional information specified in the Regulation. An Offset Project Data Report must be submitted each year. Offset Credits may be issued following verification of an offset project data report. Record keeping requirements are detailed in §95976 of the Regulation, and all specified records must be retained for 100 years following the issuance of any Offset Credits.

All reports that reference carbon stocks must be submitted with the oversight of a Professional Forester. If the project is located in a jurisdiction without a Professional Forester law or regulation, then a Professional Forester is 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.

9.1.1 Project Listing Requirements

The listing information in this section must be submitted by the Offset Project Operator or Authorized Project Designee prior to the Listing of the project. This information is also submitted as part of the first Offset Project Data Report, and is subject to verification at the initial project verification. The following listing information must be submitted no later than the date at which the Offset Project Operator or Authorized Project Designee must submit the first Offset Project Data Report:

9.1.1.1 All Projects[7]

1. Project Name.
2. Project Contact Information, including name, phone number, address, and email address for:
    a. Offset Project Operator
    b. Authorized Project Designee (if applicable);
3. 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 right to undertake and list the project.
4. Project Type (reforestation, improved forest management, or avoided conversion).
5. A description of the management activities that will lead to increased carbon stocks in the Project Area, compared to the baseline.
6. Indicate if the project occurs on public, private or tribal lands.

[7] Reforestation projects as qualified in section 6.1 can defer the items that are marked with an asterisk until the second site-visit verification.

7. Project commencement date, with an explanation and justification of the commencement date.
    a. Specify the action(s) that identify the commencement date.
8. A statement as to whether any GHG reductions or removals associated with the Project Lands have ever been listed or registered with, or otherwise claimed by, another registry or program, or sold to a third party prior to listing, including;
    a. Have any lands within the Project Area ever been listed or registered with an offset project registry or program in the past?
    b. Have greenhouse gas emission reductions or removal enhancements associated with lands within the Project Area been credited or claimed for the purpose of greenhouse gas mitigation or reduction goals, whether in a voluntary or regulatory context?
    c. If yes, identify the registry or program (include vintages and reporting period).
9. A statement as to whether the project is being implemented and conducted as the result of any law, statute, regulation, court order, or other legally binding mandate? If yes, explain.
10. Declaration that the project does *not* employ broadcast fertilization.
11. If the Forest Project is located on public land, a description and copies of the documentation demonstrating explicit approval of the project's management activities and baseline including any public vetting processes necessary to evaluate management and policy decisions concerning the project.
12. If the Forest Project is located in tribal areas, a description and copies of documentation demonstrating that the land within the Project Area is owned by a tribe or private entities.
13. If commercial harvesting is either planned or ongoing within the Project Area, a description of how the Forest Owner satisfies one of the three requirements for employing and demonstrating sustainable long-term harvesting practices on all of its forest landholdings (refer to Section 3.8.1).
14. A description of how the project meets (or will meet) the definition of "Natural Forest Management" (refer to Section 3.8.2), including:
    a. Composition of native species;
    b. Distribution of age classes / sustainable managment;
    c. Structural elements (standing and lying dead wood);
15. Descriptions and maps of the Project Area boundaries that include:
    a. Governing jurisdictions, and latitude/longitude coordinates
    b. Public and private roads (map)
    c. Towns (map)
    d. Major watercourses (4^{th} order or greater), water bodies, and watershed description (map)
    e. Topography (map)
    f. Townships, ranges, and sections or latitude and longitude (map)
    g. Existing land cover and land use (description with optional map)
    h. Forest vegetation types (description with optional map)
    i. Site classes (description with optional map)
    j. Land pressures and climate zone/classification (description with optional map)
    k. Historical land uses, current zoning, and projected land use within project area and surrounding areas (description with optional map)
16. Identify what assessment area or areas contain lands within the Project Area.
    a. Include how many acres of project lands fall within each assessment area.
    b. Include a value for total project area acreage.
17. General description of the forest conditions within the Project Area:

   a. Species (tree) composition;
   b. Age class distribution;
   c. Management history;
18. Indicate whether the project will employ a Qualified Conservation Easement.
   a. If yes, include the date the Qualified Conservation Easement was or will be recorded, the terms that affect forest management within the easement, and a provide a copy of the Qualified Conservation Easement to ARB.
19. *A description of the inventory methodology for each of the carbon pools included in the Forest Project's Offset Project Boundary. The inventory methodology must describe:
   a. The stratification rules and processes, if applicable.
   b. The sampling process, including selection of plot locations, monumenting of plots, frequency of sampling efforts, data gathering procedures, and parameters of data collected.
   c. Data management and analytical systems.
   d. An inventory monitoring plan including the annual inventory update processes, and the adjustments for harvest, growth, and disturbances over time.
   e. Methods for quality control.
20. *A description of the calculation methodologies for determining metric tons per hectare for each of the carbon pools included in the project report.
21. *A modeling plan, following the requirements and methods in Appendix B, Section B.3.
22. A diagram of the final baseline incorporating all required carbon stocks.
23. *A summary of the inventory of carbon stocks for each carbon pool.
24. *A summary of inventory confidence statistics.
25. *A description and estimate of the Forest Project's baseline onsite carbon stocks. Baseline onsite carbon stocks must be portrayed in a graph depicting time in the x-axis and metric tons CO_2-equivalent in the y-axis. The graph should be supported with written characterizations that explain any annual changes in baseline carbon stocks over time.
26. *An estimate of carbon that will be stored long-term in harvested wood products in the baseline.
27. *Projections of baseline and actual harvesting volumes from the Project Area over 100 years.
28. *Calculation of the project's reversal risk rating and contribution to the Forest Buffer Account.

9.1.1.2 Reforestation Projects

In addition to the information in Section 9.1.1.1, the following information must be provided for Reforestation projects:

1. An explanation of how the Project Lands, at the time of project initiation, 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 removed at least 20 percent of the land's above-ground live biomass. The explanation should include why the forest was out of forest cover or a description of the disturbance if a natural 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 description of how the Forest Project occurs on a type of land for which the Forest Owner has not historically engaged in or allowed timber harvesting.

3. A 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 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.
4. List any laws, statutes, regulations or other legal mandates that would encourage or require reforestation on the project area.

9.1.1.3 Improved Forest Management Projects on Private Lands

In addition to the information in Section 9.1.1.1, the following information must be provided for Improved Forest Management projects on private lands:

1. Documentation that the Project Area has greater than 10 percent tree canopy cover.
2. A determination of how the Forest Project's initial standing live carbon stocks compare to Common Practice, as required in Section 6.2.1.
3. If the Forest Project's initial standing live carbon stocks are below Common Practice, a determination of the "High Stocking Reference" for the Project Area. The High Stocking Reference is defined as 80 percent of the highest carbon stocks in live trees during the preceding 10-year period. To determine the High Stocking Reference, changes in the Project Area's live-tree carbon stocks over the preceding 10 years, or as long as the Forest Owner has had control of the stocks must be documented.
    a. Include an affidavit testifying that the inventory depicted over the past 10 years is reasonably accurate.
    b. Include a summary of volume harvested over the past 10 years.
4. Documentation of any and all legal constraints affecting forest management activities on the Project Area. The documentation of legal constraints must include:
    a. A description of each constraint (refer to Section 6.2.1.2).
    b. A narrative that describes the effect of the constraint on forest management.
    c. A description of the modeling techniques used to simulate the effects of the constraint.
5. A demonstration that the growth and harvesting regime assumed for the baseline is financially feasible following the requirements of Section 6.2.1.3.

9.1.1.4 Improved Forest Management Projects on Public Lands

In addition to the information in Section 9.1.1.1, the following information must be provided for Improved Forest Management projects on public lands:

1. Documentation demonstrating that the project takes place on land that has greater than 10 percent tree canopy cover.
2. A projection of future changes to Project Area forest carbon stocks by extrapolating from historical trends; and anticipating how current and future public policy will affect onsite carbon stocks per the requirements of Section 6.2.2.
3. An explanation of how current and future public policy will affect onsite carbon stocks and how, the baseline modeling incorporates constraints imposed by all applicable statutes, regulations, policies, plans and Activity-Based Funding.

9.1.1.5 Avoided Conversion Projects

In addition to the information in Section 9.1.1.1, the following information must be provided for Avoided Conversion projects:

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 Section 3.1.1.3.
3. A description of how the Project Area was determined, following the requirements in Section 4.
4. A full copy of the appraisal that was prepared for the Project Area per the requirements of Section 3.2.1.3.
5. A description of the highest value alternative land use identified in the appraisal.
6. An estimate the rate of conversion and removal of onsite carbon stocks per the requirements in Section 6.3.1.
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 uncertainty discount (following the requirements in Section 6.3.1).
8. Where the anticipated alternative land use is commercial, 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.
10. Where the anticipated alternative land use is commercial, 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;
    c. Population growth (people per year) within 180 miles of the Project Area.

9.2 Offset Project Data Report

Project operators or authorized project designees must submit an Offset Project Data Report each year by April 1. The report must be based on a single calendar year, as stated in the Regulation. The listing information in Section 9.1.1 must be included in the initial Offset Project Data Report, and is subject to verifier review during the initial verification. All Offset Project Data Report must include the information in section 9.2.1.

9.2.1 Annual Reporting

An Offset Project Data Report must be prepared for each calendar year during the Project Life. Offset Project Data Reports must be provided to verification bodies whenever a Forest Project undergoes verification. Offset Project Data Reports must contain an annual update of the project's forest carbon inventory (Section 8.2). Each report must also contain the following information. Reforestation Projects, as qualified in Section 6.1, can defer the items that are marked with an asterisk until submitting the offset project data report that will undergo the second verification.

1. Project Name.
2. Project Contact Information, including name, phone number, address, and email address for:

   a. Offset Project Operator
   b. Authorized Project Designee (if applicable);
3. Reporting Period.
4. A 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, a description an explanation of the non-compliance must be provided.
5. A statement as to whether all the information submitted for project Listing still accurate. If not provided updates to the relevant listing information.
6. An updated estimate of the reporting year's carbon stocks in all required carbon pools.
7. *The appropriate confidence deduction for the forest carbon inventory following the requirements and methods in Appendix A, Section A.4)
8. *An explanation of any decrease over any 10-year consecutive period in the standing live carbon pool.
9. Any changes in the status of the Forest Owner including, if applicable per Section 3.8.1, the acquisition of new forest landholdings.
10. A description of how the project meets (or will meet) the definition of "Natural Forest Management" (refer to Section 3.8.2), including progress on criteria that have not been fully met in previous years.
11. *An estimate of reporting-year harvest volumes and associated carbon in harvested wood products.
12. *Estimated mill efficiency, as determined following the method in Appendix C, Section C.2.
13. The baseline carbon stock estimates for all required carbon pools for the reporting year, as determined following the requirements in Section 6 and approved at the time of the project's registration.
14. 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.
15. The uncertainty discount for avoided conversion projects, as determined following the requirements of Section 6.3 and approved at project registration. (After the initial verification, the uncertainty discount does not change.)
16. A calculation of total net GHG reductions and removal enhancements (QR_y) for the year, following the requirements in Section 6.
17. If a reversal has occurred during the previous year, 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.
18. *The project's reversal risk rating, as determined following the requirements in Section 7 and Appendix D.
19. *A calculation of the project's Buffer Account contribution.

9.2.2 Additional Reporting for Verification Years

Forest Projects must be verified at least every six years. If verification is less frequent than annual, Offset Project Data Reports must include the following additional information on aggregated GHG emission reductions or removal enhancements since the last verification:

1. Annual estimates of carbon stocks for all required carbon pools reported during each year since the last verification.
2. Confidence deduction for the forest carbon inventory applied for each year since the last verification for the project, if applicable.

3. Baseline carbon stock estimates for all required carbon pools reported during each year since the last verification.
4. Estimate of Secondary Effects reported during each year since the last verification.
5. If a reversal has occurred during the previous six years, 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.
6. Calculation of the project's Buffer Account contribution for each year since the last verification.
7. Calculation of total net GHG reductions and removal enhancements (QR_y) reported for each calendar year since the last verification.

9.3 Reporting and Verification Cycle

Upon completion of a reporting period, the Offset Project Operator or Authorized Project Designee must annually submit an Offset Project Data Report by April 1 according to the schedule specified in the Regulation. Offset Project Data Reports must be verified (including a site visit) by an approved ARB verification body at least once every six years.

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

9.3.1 Reporting Period Duration and Cycle

A "reporting period" is a period of time for which an Offset Project Operator or Authorized Project Designee quantifies and reports GHG reductions and removals (i.e. the length of time covered by a Offset Project Data Report). The reporting period for Forest Projects must consist of a 12 month calendar year, with one exception:

1. A Forest Project's first reporting period (the reporting period that precedes initial verification) may be any length of time, lasting from the project commencement date to December 31 of the year prior to the initial verification.

All reporting periods after the first reporting period must consist of a12 month calendar year in duration. Reporting periods must be contiguous; there must be no gaps in reporting during the crediting period of a Forest Project once the first reporting period has commenced.

9.3.2 Verification Cycle

All Forest Projects must have the initial Offset Project Data Report verified within 12 months of being submitted for project listing. For any verification thereafter, projects must be verified according to the schedule specified in the Regulation. Up to 6 years of GHG reductions or removals may be verified through a single verification, which may cover multiple reporting periods.

9.3.2.1 Minimum Required Verification Schedule

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. Verification is also required anytime new confidence deductions and/or reversal risk ratings are established.

For Reforestation Projects, the second verification may be deferred up to 12 years at the discretion of the Offset Project Operator or Authorized Project Designee.

9.3.3 Issuance and Vintage

Provisions for the issuance of Offset Credits are specified in Subarticle 13 of the Regulation.

Reforestation Projects for which an initial inventory is deferred are not eligible to receive Offset Credits until after the second verification. Vintages will be assigned to Offset Credits by calendar year.

For a Forest Project's first reporting period only, if the reporting period covers more than two years, Offset Credits will be assigned a vintage according to the timing of GHG reductions or removals as determined through past inventories and modeling of changes in carbon stocks over the reporting period. If the first reporting period is two years or less, then issued Offset Credits will be assigned vintages according to the proportion of the reporting period that falls within each calendar year.

10 Verification

10.1 Regulatory Verification Requirements

Offset Project Data Reports must be verified in accordance with the regulatory verification requirements in Subarticle 13. Offset Credits will only be issued by ARB for quantified GHG reductions or removal enhancements that have been verified in accordance with these provisions. Verifiers must assess whether the submitted Offset Project Data Report is free of offset material misstatement for each calendar year of reported data, and whether the Offset Project Data Report is in conformance with the requirements of Subarticle 13 and this Compliance Offset Protocol. Failure to conform to any requirements in this protocol or Subarticle 13, as applicable, will result in an adverse verification statement or a qualified positive verification statement.

10.2 Additional Verification Requirements

In addition to the offset project verification requirements in § 95977, verification of Offset Project Data Reports for Forest Projects must include:

During the initial verification:

1. A detailed review of all required Listing Information during the initial verification.

During every verification:

2. A detailed review of the forest carbon inventory, including:
    a. Inventory methodology and sampling design;
    b. Inventory update processes;
    c. Measurement of sample plots and sample plot locations;
    d. Lifetime and updating of sample plots, as applicable;
    e. Stratification methods, if applicable;
    f. Biomass equations and calculations;
    g. Incorporation of growth and harvest modeling and data;
    h. Documentation of inventory methods and procedures, including procedures for data quality assurance and quality control.
3. Identification and re-measurement of a selection of sample plots, along with a comparison with inventory data to have reasonable assurance that sample plots are measured accurately. A minimum of 8 sample plots or 5% of the total sample plots used to develop the forest carbon inventory, whichever is greater, must be measured by the verification body. A paired t-test must be conducted to determine whether the verifier sample plot measurements are within the same population as the inventory submitted by the Offset Project Operator or Authorized Project Designee to a reasonable degree of confidence.
4. Application of appropriate confidence deductions, if applicable.
5. Review reversal risk rating calculation.
6. Review of conformance with natural forest management and sustainable harvesting requirements.
7. If verification is less frequently than annual, separately review and evaluate each calendar year of reported data specified in Section 9.2.2.

a. Each calendar year of quantified GHG reductions or removal enhancements (QR_y) is separately evaluated for offset material misstatement.

Each verification team must include at least one Professional Forester that takes in active role in reviewing the forest carbon inventory program and conducting the site visit.

11 Glossary of Terms

Above-Ground Live Biomass	The total mass of biomass in 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.
Additional	Additional is defined in the Regulation. Under this protocol, GHG reductions or removals from Forest Projects are demonstrated to be addition when they pass a legal requirements 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.
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 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.
Avoided Conversion Project	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.
Baseline	'Baseline' means 'Project Baseline' as defined in the Regulation. A baseline is a conservative estimate of business-as-usual GHG emission reductions or removals for the offset project's

	GHG emission sources, sinks and reservoirs within the offset project boundary. 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.
Biological Emissions	For the purposes of the Forest Offset 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	Biomass is defined in the regulation.
Bole	A trunk or main stem of a tree.
Broadcast Fertilization	A fertilizer application technique where fertilizer is spread across the soil surface.
Business As Usual Scenario	Business As Usual Scenario is defined in the Regulation as the set of conditions, reasonably expected to occur within the Offset Project Boundary in the absence of the financial incentives provided by offset credits, taking into account all current laws and regulations, as well as current economic and technological trends. Methodologies for determining these conditions – and/or for approximating carbon stock levels that would have resulted from these conditions – are provided in Section 6 of this protocol for each type of Forest Project.
Carbon Pool	A greenhouse gas reservoir
Common Practice	The average stocks of the standing live carbon pool from within the Forest Project's Assessment Area, derived from FIA plots on all private lands within the defined Assessment Area.
Compliance Instrument	Compliance Instrument is defined in the Regulation as an allowance, offset credit or sector-based credit. Each compliance instrument can be used to fulfill a compliance obligation

	equivalent to up to one metric ton of CO2e.
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 Buffer Account	Forest Buffer Account is defined the Regulation as a holding account for forest offset credits administered by ARB . It is used as a general insurance mechanism against unintentional reversals for all forest offset projects listed under a Compliance Offset Protocol.
Forest Management	The commercial or noncommercial growing and harvesting of forests.
Forest Owner	A Forest Owner is defined in the Regulation as the owner of any interest in the property involved in a forest offset project, but does not include the holder of a conservation easement. Generally, a Forest Owner is the owner in fee of the 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 property are collectively considered the Forest Owners. All Forest Owner(s) are ultimately responsible for all commitments associated with a forest offset project.
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.
Forestland	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.

Greenhouse Gases (GHG)	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), hydrocarbons, and other fluorinated greenhouse gases as defined in the Regulation.
Greenhouse Gas (GHG) Emissions Source	Greenhouse Gas Emissions Source or GHG Source as defined in the Regulation means, in the context of offset credits, any type of emitting activity that releases greenhouse gases into the atmosphere.
Greenhouse Gas (GHG) Reduction	GHG Reduction as defined in the Regulation means a calculated decrease in GHG emissions relative to a project baseline over a specified period of time.
Greenhouse Gas (GHG) Removal	GHG Removal as defined in the Regulation means the calculated total mass of a GHG removed, relative to a project baseline, from the atmosphere over a specified period of time.
GHG Removal Enhancement	GHG removal enhancement is defined in the Regulation as a calculated increase in GHG removals relative to a project baseline. In forest projects, GHG removal enhancements are calculated as gains in carbon stocks over time relative to a Forest Project's baseline
Greenhouse Gas (GHG) Reservoir	Greenhouse Gas Reservoir is defined in the Regulation as a physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store, accumulate, or release a GHG removed from the atmosphere by a GHG sink or a GHG captured from a GHG source. In the case of forests, GHG reservoirs may include above-ground or below-ground biomass or harvested wood products, among others.
Greenhouse Gas (GHG) Sink	Greenhouse Gas Sink or GHG Sink as defined in the Regulation means a physical unit or process that removes a GHG from the atmosphere.
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.
Intentional Reversal	Intentional Reversal as defined in the Regulation means any reversal caused by a Forest Owner's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the area within the Project Area.
Listed	A Forest Project is considered "listed" when an the Offset Project Operator or Authorized Project Designee is registered with ARB or an approved

	offset project registry, submits all required documentation for project listing in the regulation and this protocol, and the project has been approved by ARB or an approved offset project registry 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 5" and a minimum length of 8'. Anything not meeting the measurement criteria for lying dead wood will be considered litter. Stumps are not considered lying dead wood.
Metric ton (MT) or "ton"	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1023 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 the Section 3.8.2.
Non-Forest Cover	Land with a tree canopy cover of less than 10 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.
Offset Credit	Offset credit is defined in the Regulation, and means a tradable compliance instrument issued or approved by ARB that represents a GHG reduction or removal enhancement of one metric

	ton of CO2e. The GHG reduction or GHG removal enhancement must be real, additional, quantifiable, permanent, verifiable and enforceable.
Offset Project Boundary	Offset Project Boundary as in the Regulation is defined by and includes all GHG emission sources, sinks, and reservoirs that are affected by an offset project and under control of the offset project operator. GHG sources, sinks or reservoirs not under control of the offset project operator are not included in the offset project boundary. Under this protocol, the offset project boundary is defined for each project type in Section 5. All GHG emission sources, sinks, and reservoirs within the offset project boundary must be accounted for in quantifying a Forest Project's GHG reductions and removals (Section 6).
Offset Project Data Report	Offset Project Data Report is defined in the Regulation as the report prepared by an Offset Project Operator or Authorized Project Designee each year that provides the information and documentation required by the regulation and this compliance offset protocol.
Onsite Carbon Stocks	Carbon Stock as defined in the Regulation means "the quantity of carbon contained in an identified GHG reservoir." For forest projects onsite carbon stocks include the carbon stocks in the required carbon pools indicated in Table A.1 within the Project Area.
Permanent	Permanent, as defined in the Regulation means either that GHG reductions or GHG removal enhancements are not reversible, or when GHG reductions or GHG removal enhancements may be reversible, that mechanisms are in place to replace any reversed GHG emission reductions or GHG removal enhancements to ensure that all credited reductions endure for a period that is comparable to the atmospheric lifetime of an anthropogenic CO2 emission. For Forest Projects, this requirement is met by requiring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.
Primary Effect	The Forest Project's intended changes in carbon stocks, GHG emissions, or GHG removals.
Professional Forester	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.
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.
Public Lands	Lands that are owned by a public governmental body such as a municipality, county, state, or country.
Qualified Conservation Easement	A qualified conservation easement must explicitly refer 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 minimum time commitment, as defined in Section 3.4 of this protocol.
Reforestation Project	A type of Forest Project involving the restoration of tree cover on land that currently has no, or minimal, tree cover.
Retire	To retire a compliance instrument, as defined in the Regulation, means that the serial number for a compliance instrument is registered into the Retirement Compliance Account. Compliance instruments registered into this account cannot be used for further compliance.
Reversal	A reversal as defined in the Regulation means a GHG emission reduction or GHG removal enhancement, for which ARB has issued an offset credit, that is subsequently released or emitted back into the atmosphere due to any intentional or unintentional circumstance. Under this protocol, a reversal is deemed to have occurred if the quantified GHG reductions and removals in a given year are negative and offset credits were issued to the Forest Project in any previous year, regardless of the cause of the

	decrease.
Secondary Effects	Unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the Forest Project.
Sequestration	Sequestration is defined in the Regulation as the removal and storage of carbon from the atmosphere in GHG sinks or GHG reservoirs through physical or biological processes.
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 Forest Owner.
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 biomass. Live trees include the stem, branches, roots, and leaves or needles of all live biomass, regardless of species, with a minimum diameter (breast height) of five inches and a minimum height of 15 feet.
Stocks (or Carbon Stocks)	The quantity of carbon contained in identified GHG reservoir (or carbon pool).
Submitted	A Forest Project is “submitted” when all of the appropriate forms have been uploaded and submitted.
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 5 inches and a minimum height of 15 feet with no branches within 3 feet from the ground at maturity.
Unintentional Reversal	An unintentional reversal as defined in the Regulation is any reversal not due to the Forest Owner’s negligence, gross negligence or willful intent, including wildfires or disease that are not the result of the Forest Owner'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.

Appendix A Developing an Inventory of Forest Project Carbon Stocks

Quantification Methodology

This appendix provides requirements for quantifying a Forest Project's forest carbon stocks. It explains how to identify the required forest carbon pools measured in a Forest Project, as well as the steps necessary for quantifying the existing carbon stocks in the selected pools within the Project Area. Carbon inventory information serves two purposes:

1. It is used as the basis for modeling and estimating carbon stocks in a project's baseline (following the requirements of Section 6).
2. It is used to quantify actual carbon stocks during the course of a project.

This appendix explains the essential steps and requirements for completing a carbon inventory for all required onsite carbon pools associated with a Forest Project.

A.1 Provide Background Information on Forest Area

To begin the inventory process, develop a general description of the activities and land use patterns that influence carbon stocks in the Project Area. This information will help inform the initial design of the forest inventory, as well as the estimations of carbon stocks. This information will be reviewed during verification.

At the time the Forest Project is submitted for Listing, the following information must be provided in map form (per Section 4), with the following information:

- Public and private roads
- Towns
- Major watercourses (4^{th} order or greater)
- Topography
- Townships, ranges, and sections or latitude and longitude

Additionally the following information about the Project Area must be provided in narrative form, with maps optional:

- Existing land cover and land use
- Forest vegetation types and descriptions (including forest species identification, proportions, and trends in project area)
- Site classes
- Land pressures and climate zone/classification
- Historical land uses, current zoning, and projected land use within project area and surrounding areas
- Major watercourses, water bodies and watershed description

A.2 Measure Carbon Pools in the Project Area

Forest carbon pools are broadly grouped into the following categories:

1. Living biomass
2. Onsite dead biomass
3. Soil

Values for some of these categories of carbon will be determined through direct sampling. Table A.1 indicates the categories with their associated carbon pools and identifies which pools must

be quantified for all projects versus those are excluded depending on the project. It also shows how the value for the pool is determined.

Table A.1. Requirements of carbon pool categories and determination of value for pool

Category	Carbon Pool	Improved Forest Management	Reforestation	Avoided Conversion	Determination of Value
Living biomass	Standing Live	Required	Required*	Required	Sampled in Project
	Shrubs and Herbaceous Understory	Excluded	Required	Excluded	Sampled in Project
Onsite dead biomass	Standing Dead	Required	Required	Required	Sampled in Project
Soil	Soil**	Required/ Excluded**	Required/ Excluded**	Required/ Excluded**	Sampled in project

* 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 first seeks verification of GHG reductions and removals (subsequent to the project's initial site-visit verification and registration).
** Soil carbon is not anticipated to change significantly as a result of most Forest Project activities. Soil carbon must be included in the inventory, however, if any of the following activities occur:

- Site preparation activities involve deep ripping, furrowing, or plowing where soil disturbance exceeds 25 percent of the Project Area, or
- Mechanical site preparation activities are not conducted on contours.

A.3 Developing Onsite Forest Carbon Inventories

To develop estimates of carbon stocks in the carbon pools identified in Table A.1, a forest inventory must first be conducted. Standard forest inventories require the establishment of sample plots and provide inventory estimates in terms of cubic or board foot volume. These measurements are based on the species, trunk or bole diameter, form and height of the tree.

Each Offset Project Operator must develop and document a forest carbon inventory methodology. The inventory method must be capable of quantifying carbon stocks for required carbon pools to a high degree of accuracy. A complete inventory methodology must include:

1. A description of the Offset Project Boundary, including a list of all carbon pools included in the Offset Project Boundary.
2. For each carbon pool, include a detailed description of the inventory sampling methodology used to quantify that carbon pool, with references clearly documented. This documentation must include:
    a. Standard procedures for the collecting of field measurements. These procedures must be detailed enough so that any qualified forester would be able to accurately repeat the previous measurements. Must include a description of the types of sample plots, location of plots, and frequency for updating or replacing sample plots as well as the forest carbon inventory as a whole;
    b. Standard procedures for where and how to measure parameters used in biomass calculations such as dbh and height (including for irregular trees), how to classify

dead wood, and for any other aspects of sampling where a consistent method needs to be documented; and

c. 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), and a discussion of how boundaries were determined.

3. Documentation of all analytic methods and biomass equations used to translate field measurements into volume or biomass carbon estimates;
4. 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 assessing and ensuring the quality of collection, transfer and archiving of field data; procedures for data entry and analysis, and data maintenance and archiving; and any other relevant procedures to ensure quality and consistency in the collection and maintenance of data used to compile the offset project data reports.
5. Description of data management systems and processes, including the collection, storage and analysis of inventory related data analytical methods to translate field measurements into volume and/or biomass estimates.
6. A change log documenting any changes in the inventory methods or equations used to calculate carbon stocks.
7. Standard procedures for updating the forest carbon inventory. Must include documented procedures to account for:
    a. Harvest;
    b. Growth;
    c. Disturbance;
    d. Incorporating new inventory and plot data, and retiring older sample plots;
    e. Modeling, as allowed under Appendix B; and
    f. Application of appropriate confidence deduction.

Inventory methods and sampling procedures, once established, must be consistent over the life of the project. Any changes to inventory methods or calculations must be documented and justified in the change log.

Allometric Equations and Biomass/Carbon Mass Estimates

The equations in this appendix and in Forest Offset Protocol Resources on ARB's webpage must be used for biomass and carbon mass estimations using the bole diameter and total height for live trees and sound standing dead trees. Estimates of standing dead tree (for non-sound trees) biomass must be computed in terms of cubic volume and subsequently converted to biomass/carbon mass estimates.

Sample Plots

Any plot data used for deriving the forest carbon inventory estimates must have been sampled within the last 12 years. The scheduling of plot sampling may occur in one time period or be distributed over several time periods. 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.

Steps for Developing a Complete Forest Carbon Inventory

The steps that follow provide more detail on establishing and maintaining a complete inventory and estimating carbon stocks. Results must be summarized in a table when submitting required data in an Offset Project Data Report (see Section 9).

Step 1 – Developing Inventory Methodology and Sample Plots

The Offset Project Operator or Authorized Project Designee must develop and describe a methodology to sample for biomass or volume of all required carbon pools. If a pre-existing forest inventory is used to develop a forest carbon inventory, all steps here must be followed to ensure the existing inventory meets the requirements of this protocol.

Sampling methodology and measurement standards should be consistent throughout the duration of the Forest Project. If new methodologies are adopted, they must achieve an equal or greater accuracy relative to the original sampling design. All sampling methodologies and measurement standards must be statistically sound and must be approved during verification.

Stratification is not required, but it may simplify verification. Temporary flagging of plot center, as is customary to allow for check cruising, is required to ensure ongoing inventory quality and allow for verifiers to visit plots when verifying inventory procedures. If permanent plots are used, which are statistically efficient for stock change estimates, permanent plot monumenting must be sufficient for relocation. Plot centers should be referenced on maps, preferably with GPS coordinates. The methodologies utilized must be documented and made available for verification and public review. The design of the sampling methodology and measurement standards must incorporate the requirements in the following table.

Table A.2. Minimum required sampling criteria for estimated pools

Carbon Pool	Name of Requirement	Description of Requirement
Standing Live Trees (above-ground portion)	Diameter (breast height) Measurements	The stated minimum diameter in the methodology must not be greater than 5 inches (12.7 cm).
	Measurement Tools	Description of tools used for height measurement, diameter measurement, and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for tree and plot size measurements.
	Plot Layout	A description of plot layout.
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be included in the sampling design.
	Allometric Equation used for Estimating Biomass	The methodology must include a description of the allometric equation used to estimate the whole tree biomass (bole, branches, and leaves) from bole diameter measurements. The use of functions other than those provided in the protocol will need to be approved by ARB and the verification body.
Standing Live Trees (below-ground portion)	Plot-level Allometric Equation used for Estimating Biomass	Apply model (Cairns, Brown, Helmer, & Baumgardner, 1997) to estimate below-ground biomass density. This model equation is based on above-ground biomass density in tons per hectare. The use of a function other than that provided in the protocol will need to be approved.
Herbaceous Understory	Sampling Methodology	The sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004). Alternative methodologies need to be reviewed and approved by ARB and the verification body.
Standing Dead Trees	Diameter (breast height) and top Diameter Measurements	The stated minimum breast height diameter in the methodology must not be greater than 5 inches. The minimum height of standing dead trees is 15'. Include a description of how top diameter is derived.
	Measurement Tools	Description of tools used for height, diameter and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for height and diameter measurements.
	Plot Layout	A description of plot layout (may be the same layout as for live tree biomass).
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be including in the sampling design.

Step 2 – Estimating Carbon in Live Trees from Sample Plots

Standing live tree carbon estimates are required for all projects. The standing live tree estimate includes carbon in all portions of the tree, including the bole, stump, bark, branches, leaves, and roots. The Offset Project Operator or Authorized Project Designee is responsible for determining appropriate methodologies for sampling to determine standing live tree carbon stocks. The estimate of above-ground live tree biomass must be combined with the estimates of biomass from other carbon pools to determine a mean estimate of the included pools derived from sampling, along with a summary that describes the statistical confidence of the estimate. Biomass estimates are converted to carbon estimates as described below.

The equations in Table A.3 are provided for a few common California species for estimating tree biomass from diameter (DBH) and total height (HT) measurements. This list does not contain all species that may be encountered in a Forest Project. Other approved biomass equations will be available in Forest Offset Protocol Resources on ARB's website.

For the equations below, diameter measurements are in inches and height measurements are in feet. The bole total volume (VOL) is calculated first and then multiplied by the wood density value for each species. This result is divided by 2.204622 to convert from pounds to kilograms. Conifer species have separate functions for bole, live crown, and bark biomass. Some hardwood species have volume functions that include these elements and therefore only one equation is used. The appropriate volume function for each species is cited in the following references: Means, Hansen; Koerper, Alaback, & Klopsch (1994) and Waddell & Hiserote (2005).

Table A.3. Sample of the Equations for Tree Species Biomass Estimates

Species	Bole Biomass (kg)	Bark Biomass (kg)	Live Crown Biomass (kg)
Douglas-fir	(VOL x 28.70) / 2.204622	Exp(-4.3103+2.43 x ln(DBH x 2.54))	Exp(-3.6941+2.1382 x ln(DBH x 2.54))
Ponderosa pine	(VOL x 23.71) / 2.204622	Exp(-3.6263+1.34077 x ln(DBH x 2.54)+ 0.8567 x ln(HT*0.3048))	Exp(-4.1068+1.5177 x ln(DBH x 2.54)+ 1.0424 x ln(HT*0.3048))
Coast redwood	(VOL x 21.22) / 2.204622	Exp(7.189689+1.58375 x ln(DBH x 2.54))/1000	0.199+0.00381 x (DBH x 2.54)^2 x (HT x 0.3048)
Tanoak*	(VOL x 36.19) / 2.204622		
*Tanoak biomass is in one equation because it includes the bole, bark and crown volumes.			

The derived estimate of biomass must be multiplied 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.

Because of the difficulties associated with measuring the below-ground carbon component of trees, the estimation of this component of tree carbon through the use of a regression equation (Cairns, Brown, Helmer, & Baumgardner, 1997) is allowed. This equation provides a practical and cost-effective approach that estimates below-ground biomass of standing live trees using the sampling-based calculation of above-ground biomass of standing live trees only:

$$BBD = \exp(-0.7747 + 0.8836 \times \ln(ABD))$$

Where:

BBD = below-ground biomass density of standing live trees in tons per hectare
ABD = above-ground biomass density of standing live trees in tons per hectare

This equation must be applied at the plot level, after estimates of above-ground biomass have been calculated as described above.

Example A.1. Quantification Example (Part III – Tree Biomass)

The chart below displays summary data for tree biomass for the first plot in Strata 1.

Tree Biomass								
1	2	3	4	5	6	7	8	9
Plot	Tree Number	Species	DBH (cm)	Total Height (m)	Status	Biomass (kg)	Weight (Expansion per Hectare)	Biomass (kg per Hectare)
1	1	Redwood	65	32	L	2,560	21	53,768
1	2	Douglas-fir	65	29	L	2,007	21	42,152
1	3	Tanoak	28	14	L	280	112	31,402
1	4	Redwood	68	30	L	2,677	19	50,858
1	5	Redwood	76	27	L	3,086	15	46,287
1	6	Douglas-fir	65	34	L	2,310	21	48,501
1	7	Tanoak	42	17	L	729	50	36,442
1	8	Tanoak	46	18	L	914	41	37,464
							Total	346,874

The plot in this example was measured using a 30 square foot basal area factor prism. The plot number is entered in column 1. All 'in' trees (trees on the plot) are measured and input consecutively starting at North and proceeding clockwise (this facilitates check cruising, quality control). Each tree is numbered (column 2), the species documented (column 3), the DBH measurements entered as centimeters in column 4, and the total height entered as meters in column 5.

The status of the tree goes in column 6. The status codes are shown below.

Status Codes	Description
L	Live
D1	Dead, with large and small branches and twigs
D2	Dead, with large and small branches and no twigs
D3	Dead, with large branches only
D4	Dead, with no branches

Only live trees are input into the Tree Biomass worksheet. The biomass for each tree is determined (column 7) using the volume, mass, and allometric equations provided in Step 2. The basal area factor and each tree's diameter (breast height) are used to determine the expansion factor, or weight, of each tree (column 8). The expansion factor is multiplied by each tree's biomass to portray the biomass estimate of each tree on a per hectare basis (column 9). Each tree's expanded biomass is summed to calculate the estimated total biomass in trees on plot 1. Plot 1's estimate of above-ground tree biomass in Strata 1 is calculated to be 346,874 kilograms per hectare. Based on this estimate, an estimate of below-ground biomass on a per hectare basis can be calculated using the equation above. The estimate of below-ground biomass is 80,918 kilograms per hectare. The combined estimate of biomass in Plot 1 is 427,792 kilograms per hectare.

Step 3 – Estimating Carbon Standing Dead Tree Carbon from Sample Plots

An inventory of carbon stocks in standing dead tree carbon is required for all Forest Projects. The Offset Project Operator or Authorized Project Designee must provide a sampling methodology for standing dead tree carbon as part of an overall sampling strategy (discussed in Step 1). The estimate of standing dead tree carbon for highly decayed trees (broken tops, missing branches, etc.), must be calculated first volumetrically and subsequently converted to

biomass and carbon tons. Sound dead trees can be computed using the equations provided for live trees in Step 2. The equations used in Step 2 provide an estimate of biomass in kilograms. The estimate must be converted to metric tons of carbon by multiplying the result by 0.001 tons/kg.

For those trees where volume is computed, the volume will need to be converted to biomass density by applying conversion factors based on a sub-sample of material that represents the species groups and decomposition classes. The methodology developed for standing dead biomass must include a description of the calculation techniques used to determine biomass density by decomposition classes and species groups. The estimate of biomass density must be computed in terms of metric tons of carbon on a per hectare basis. A description of a methodology to generate the density factors can be found in the Brown, Shoch, Pearson, & Delaney (2004) document mentioned in Table A.2. Alternatively, the density factors by decay class from Harmon et al (2008) may be used to estimate density in standing dead trees.

Step 4– Estimate Carbon in Shrubs and Herbaceous Understory from Sample Plots

Any methodology developed for measuring carbon in shrubs must be reviewed during verification. Inventory estimates for shrubs must be computed in terms of metric tons of carbon. The most applicable biomass estimation methods may be used, including photo series, the estimation functions from published papers, direct sampling, or combinations of approaches.

Step 5 – Estimate of Carbon Tons in Soil

Changes in total soil carbon are a challenge to measure over short timeframes, as this pool changes slowly and is usually dependent on the rate of biomass input relative to soil decomposition. The sampling methodology and protocols for deriving carbon estimates in soil must be developed as part of an overall sampling strategy (discussed in Step 2). Use the soil sampling methodology prepared by Brown, Shoch, Pearson, & Delaney (2004). Estimates must be computed in terms of metric tons of carbon.

Step 6 – Sum Carbon Pools

The metric tons of carbon in each carbon pool, as derived from the preceding steps, must be entered in the following table. For the purpose of quantifying GHG reductions and removals, all numbers must be converted to metric tons of CO_2-equivalent by multiplying by 3.664.

Table A.4. Worksheet for Summarizing Carbon Pools and Calculating Total Carbon

Carbon Pool	Gross Carbon Tons per Hectare	Gross CO_2-equivalent Tons per Hectare
Step 2 Live Trees	From sampling results of trees.	
Steps 3 Standing Dead Trees	From sampling results of standing dead biomass and lying dead biomass.	
Step 4 Shrubs and Herbaceous Understory	From sampling results of shrubs and herbaceous understory.	
Step 5 Soil	From sampling results of soil.	
Sum of CO_2-equivalent Tons from Required Pools		

A.4 Applying a Confidence Deduction

Any forest carbon inventory estimate will be subject to statistical uncertainty. Where statistical confidence is low, there is a higher risk of overestimating a project's actual carbon stocks and therefore a higher risk of over-quantifying GHG reductions and removals. To help ensure that estimates of GHG reductions and removals are conservative, a confidence deduction must be applied each year to the inventory of actual onsite carbon stocks. A confidence deduction is *not* applied to the forest carbon inventory when it is used to model baseline carbon stocks.

To determine the appropriate confidence deduction, perform the following:

1. Compute the standard error of the inventory estimate (based on the carbon in standing live and standing dead carbon pools).
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.
4. Consult Table A.5 to identify the percent confidence deduction that must be applied to the inventory estimate for the purpose of calculating GHG reductions and removals (i.e. variable CD_y in Equation 6.1 in Section 6).

Table A.5. 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%
5.1 to 19.9%	(Sampling Error – 5.0%) to the nearest $1/10^{th}$ percentage
20% or greater	100%

The confidence deduction must be updated each time the project is subject to verification, but must remain unchanged between verifications. 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 calendar year subject to verification at that time. Offset Credits may be issued in the most recent calendar year for any verified increase in quantified GHG reductions and removals associated with the new (lower) confidence deduction. Conversely, 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 calendar year subject to verification at that time. Any resulting decrease in quantified GHG reductions and removals from prior years as a result of the increased confidence deduction will be treated as an intentional reversal, and must be compensated for by retiring Compliance Instruments in accordance with Section 7.3.2.

Appendix B Modeling Carbon Stocks

Quantification Methodology

This protocol requires the use of certain empirical-based models to estimate the baseline carbon stocks and project stocks of selected carbon pools within the Project Area. These models may also be used to supplement assessments of actual changes in carbon stocks resulting from the Forest Project.

B.1 About Models and Their Eligibility for Use with Forest Projects

Empirical-based models are used for estimating existing values where direct sampling is not possible or cost-effective. They are also used to forecast the estimations derived from direct sampling into the future. Field measurements provide the basis for inferring value through the use of these models.

The models that simulate growth projections have two basic functions in the development and management of a forest project. Models project the results of direct sampling through simulated forest management activity. These models, often referred to as growth and yield simulation models, may project information regarding tree growth, harvesting, and mortality over time – values that must ultimately be converted into carbon in an additional step. Other models may combine steps and estimate tree growth and mortality, as well as changes in other carbon pools and conversions to carbon, to create estimated projections of carbon stocks over time.

Models are also used to assist in updating inventory plots so that the plots can represent a reporting year subsequent to their actual sample date. The model simulates the diameter and height increment of sampled trees for the length of time between their sampled date and the reporting year. The limit to the use of models for updating plot data is described in Appendix A.

The following growth models have been approved:

- CACTOS: California Conifer Timber Output Simulator
- CRYPTOS: Cooperative Redwood Yield and Timber Output Simulator
- FVS: Forest Vegetation Simulator
- SPS: Stand Projection System
- FPS: Forest Projection System
- FREIGHTS: Forest Resource Inventory, Growth, and Harvest Tracking System
- CRYPTOS Emulator
- FORESEE

Inventory plot data may be updated for estimating diameter and height growth by incorporating data obtained from sample plots, as in a stand table projection. To qualify for this method:

- The Project Area shall be stratified into even-age management and uneven-age management.
- Diameter increment shall 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 shall be added for each year according to the plot’s sample date.
- Height increment shall be based on regression curves for each management type (even-age or uneven-age) developed from height measurements from the same trees the

diameter increment data was obtained. The estimated height shall be determined using the regression estimators for the 'grown' diameters as described above.

Additional models will be allowed following approval of a state forestry authority (i.e. a state agency responsible for oversight of forests) who will acknowledge in writing that the model:

- Has been peer reviewed in a process that: 1) primarily involved reviewers with necessary technical expertise (e.g. modeling specialists and relevant fields of biology, forestry, ecology, etc.), and 2) was open and rigorous
- Is parameterized for the specific conditions of the Project Area
- Limits use to the scope for which the model was developed and evaluated
- Is clearly documented with respect to the scope of the model, assumptions, known limitations, embedded hypotheses, assessment of uncertainties, and sources for equations, data sets, factors or parameters, etc.
- Underwent a sensitivity analysis to assess model behavior for the range of parameters for which the model is applied
- Is reviewed at least every 10 years

B.2 Using models to forecast carbon stocks

The use of simulation models is required for estimating a Forest Project's baseline carbon stocks. Models may also be required to forecast actual carbon stocks expected under the Forest Project (e.g. in conjunction with determining expected harvesting volumes or in updating forest carbon inventories).

Inventory information from Appendix A must be incorporated into the simulation models to project carbon stocks over time. If a model has the ability to convert biomass to carbon, it must include all the carbon pools required by this protocol.

Projected baseline or actual carbon stocks must be portrayed in a graph depicting time in the x-axis and carbon tons in the y-axis. Baseline carbon stocks must be projected forward from the date of the Forest Project's initiation. The graph should 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 Section 6.

B.3 Modeling Requirements

A modeling plan must be prepared that addresses all required forecasting or updating of baseline and actual carbon stocks for the Forest Project. The modeling plan shall contain the following elements:

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).
    c. Regeneration assumptions.
2. A list of all legal constraints that affect management activities on the Project Area. This list must identify and describe the constraint and discuss 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.
4. A description of the model used and an explanation of how the model was calibrated for local use, if applicable.

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.
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.

Appendix C Estimating Carbon in Wood Products

Quantification Methodology

Wood products may constitute a reservoir for storing carbon over the long term. Projects that increase wood product production can receive credit for the resulting incremental carbon storage. By the same token, projects that reduce wood product production must account for the incremental *reduction* in stored wood product carbon. As indicated in Section 7, GHG reductions and removals must be effectively "permanent," meaning that sequestered carbon associated with GHG reductions and removals must remain stored for at least 100 years. Wood product carbon is estimated by calculating the average amount of carbon that is likely to remain stored in wood products over a 100-year period.

The processes described here are adapted from the 1605(b) methodology (U.S. Department of Energy, 2007) for accounting for the long-term storage of wood products. Please see Smith, Heath, Skog, & Birdsey (2006) for a more detailed description since the 1605(b) procedure was adapted from this publication.

Because of the significant uncertainties associated with predicting wood product carbon storage over 100 years, the accounting requirements in this appendix are designed to err on the side of conservativeness. This means the calculations are designed to reduce the risk of overestimating the GHG reductions and removals achieved by a Forest Project. One of the largest sources of uncertainty is predicting the amount of wood product carbon likely to be stored in landfills. To accommodate this uncertainty, and ensure that Forest Project GHG reductions and removals are accounted for conservatively:

1. Landfill carbon storage is *excluded* from calculations of wood-product carbon in years where a Forest Project's actual harvesting volumes exceed estimated baseline harvesting volumes, as determined in Section 6.
2. Landfill carbon storage is *included* in calculations of wood-product carbon in years where a Forest Project's actual harvesting volumes are below estimated baseline harvesting volumes, as determined in Section 6.

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.

There are five steps required to determine carbon stored in wood products:

1. Determining the amount of carbon in harvested wood that is delivered to mills.
2. Accounting for mill efficiencies.
3. Estimating average carbon storage over 100 years in in-use wood products.
4. Estimating average carbon storage over 100 years in wood products in landfills (when applicable).
5. Summing the results to determine total average carbon storage over 100 years.

C.1 Determine the Amount of Carbon in Harvested Wood Delivered to Mills

The following steps must be followed to determine the amount of carbon in harvested wood:

1. Determine the amount of wood harvested (actual or baseline) that will be delivered to mills, by volume (cubic feet) or by green weight (lbs.), and by species for the current year (y). In all cases, harvested wood volumes and/or weights must exclude bark.

   a. Baseline harvested wood volumes and species are derived from modeling a baseline harvesting scenario, following the requirements in Section 6.
   b. Actual harvested wood volumes and species must be based on verified third-party scaling reports, where available. Where not available documentation must be provided to support the quantity of wood volume harvested.
2. If a volume measurement is used, multiply the cubic foot volume by the appropriate wood density factor in Table C.1 (for projects located in the Pacific Southwest) or from the USFS Wood Handbook (other regions).[8] This results in pounds of biomass with zero moisture content.
3. If a weight measurement is used, subtract the water weight based on the moisture content of the wood. This results in pounds of biomass with zero moisture content.
4. Sum the dry weights for each harvested species to get a total dry weight for all harvested wood.
5. Multiply this total value by 0.5 pounds of carbon/pound of wood to compute the total carbon weight.
6. Divide the total carbon weight by 2,204.6 pounds/metric ton to convert to metric tons of carbon. This value is used in the next step, accounting for mill efficiencies.

Table C.1. Specific gravity and Wood Density of green softwoods and hardwoods by forest type for the Pacific Southwest from Table 1.4.

Forest Type	Specific Gravity of Softwoods	Specific Gravity of Hardwoods	Wood Density of Softwoods (lbs/ft^3)	Wood Density of Hardwoods (lbs/ft^3)
Mixed conifer	0.394	0.521	24.59	32.51
Douglas-fir	0.429	0.483	26.77	30.14
Fir-spruce-hemlock	0.372	0.510	23.21	31.82
Ponderosa pine	0.380	0.510	23.71	31.82
Redwood	0.376	0.449	23.46	28.02

C.2 Account for Mill Efficiencies

Multiply the total carbon weight (metric tons of carbon) derived in C.1 by the mill efficiency identified for the project's Assessment Area in the Forest Offset Protocol Resources section of ARB's website. This is the total carbon transferred into wood products. The remainder of the harvested carbon is considered to be immediately emitted to the atmosphere for accounting purposes in this protocol.

C.3 Estimate the Average Carbon Storage Over 100 Years in In-Use Wood Products

The amount of carbon that will remain stored in in-use wood products for at least 100 years depends on the rate at which wood products either decay or are sent to landfills. Decay rates depend on the type of wood product that is produced. Thus, in order to account for the decomposition of harvested wood over time, a decay rate is applied to wood products according

[8] The Wood Handbook (USFS, 2010) contains specific gravities for tree species in other regions. Multiply the specific gravity by the density of water (62.43 lbs/ft^3) to get wood density.

to their product class. To approximate the climate benefits of carbon storage, this protocol accounts for the average amount of carbon stored over 100 years. Thus, decay rates for each wood product class have been converted into "average storage factors" in Table C.2, below.

To determine the average carbon storage in in-use wood products over 100 years, the first step is to determine what percentage of a Project Area's harvest will end up in each wood product class (Columns A-G in Table C.2). This must be done by either:

1. Obtaining a verified report from the mill(s) where the Project Area's logs are sold indicating the product categories the mill(s) sold for the year in question; or
2. If a verified report cannot be obtained, looking up default wood product classes for the project's Assessment Area, as given in the **Error! Reference source not found.**Forest Offset Protocol Resources section of ARB's website.

If breakdowns for wood product classes are not available from either of these sources, classify all wood products as "miscellaneous."

Once the breakdown of in-use wood product categories is determined, use the worksheet in Table C.2 to estimate the average amount of carbon stored in in-use wood products over 100 years:

1. Assign a percentage to each product class (columns A-G) according to mill data or default values for the project.
2. Multiply the total carbon transferred into wood products (determined in Section C.2) by the percentages in each column and insert the resulting values into boxes 3A through 3G.
3. Multiply the values in 3A-3G by the 100-year average storage factor and insert the results into boxes 4A through 4G.
4. Use Equation C.1 to calculate the average carbon stored in in-use wood products over 100 years (in units of CO_2-equivalent metric tons).

Equation C.1. Average Carbon Stored in In-Use Wood Products

$$\mathbf{WP_{in\text{-}use,\ y} = \sum(Table\ C.2,\ Row\ 4) \times 3.67}$$

Where,

$WP_{in\text{-}use,\ y}$ = Average carbon stored in in-use wood products over 100 years from wood harvested in year y (actual or baseline)

Table C.2. Worksheet to Estimate Long-Term Carbon Storage In In-Use Wood Products

	A	B	C	D	E	F	G
Wood Product Class	Softwood Lumber	Hardwood lumber	Softwood Plywood	Oriented Strandboard	Non Structural Panels	Miscellaneous Products	Paper
% in each class	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)

Metric tons C in each class	(3A)	(3B)	(3C)	(3D)	(3E)	(3F)	(3G)
100-year average storage factor (in-use)	0.463	0.250	0.484	0.582	0.380	0.176	0.058
Average C stored in in-use wood products (metric tons)	(4A)	(4B)	(4C)	(4D)	(4E)	(4F)	(4G)

C.4 Estimate the Average Carbon Storage Over 100 Years for Wood Products in Landfills

Wood product carbon in landfills is only calculated for years in which a Forest Project's actual harvesting volumes are below estimated baseline harvesting levels, as determined in Section 6. To determine the appropriate value for average landfill carbon storage, perform the following steps:

Step 1 – Calculate the average carbon storage over 100 years for wood products in landfills

Use the worksheet in Table C.3 to estimate the average amount of wood product carbon stored in landfills over 100 years:

1. Assign a percentage to each product class (columns A-G) according to mill data or default values for the project (as determined in Section C.3).
2. Multiply the total carbon transferred into wood products (determined in Section C.2) by the percentages in each column and insert the resulting values into boxes 3A through 3G.
3. Multiply the values in 3A-3G by the 100-year average storage factor for landfill carbon and insert the results into boxes 4A through 4G.

Table C.3. Worksheet to Estimate Long-Term Carbon Storage in Wood Products in Landfills

	A	B	C	D	E	F	G
Wood Product Class	Softwood Lumber	Hardwood lumber	Softwood Plywood	Oriented Strandboard	Non Structural Panels	Miscellaneous Products	Paper
% in each class	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)	(X%)
Metric tons C in each class	(3A)	(3B)	(3C)	(3D)	(3E)	(3F)	(3G)
100-year average storage factor (landfills)	0.298	0.414	0.287	0.233	0.344	0.454	0.178
Average C stored in landfills (metric tons)	(4A)	(4B)	(4C)	(4D)	(4E)	(4F)	(4G)

Step 2 – Determine the appropriate value to use for wood product carbon in landfills

Use Equation C.2. Average Wood Product Carbon Stored in Landfills to determine the appropriate value for the average wood product carbon stored in landfills over 100 years (in units of CO_2-equivalent metric tons).

Equation C.2. Average Wood Product Carbon Stored in Landfills

$$If \sum_{n=1}^{y-1} (AC_{hv,n} - BC_{hv,n}) < 0, then\ WP_{landfill,y} = \sum (Table\ C.3, Row\ 4) \times 3.67$$

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

Where,

$WP_{landfill,\ y}$	=	Average carbon stored in wood products in landfills over 100 years from wood harvested in the current year/reporting period (actual or baseline)
$AC_{hv,\ n}$	=	Actual amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons
$BC_{hv,\ n}$	=	Estimated average baseline amount of onsite carbon harvested in reporting period n (prior to delivery to a mill), expressed in CO_2-equivalent tons
y	=	The current year or reporting period

C.5 Determine Total Average Carbon Storage in Wood Products Over 100 Years

The total average carbon storage in wood products over 100 years for a given harvest volume (as determined in Section C.1) must be calculated and reported as follows (Equation C.3). The value derived for WP_{total} must be used for actual and baseline wood product carbon estimates ($AC_{wp,y}$ or $BC_{wp,y}$ in Equation 6.1) as appropriate, following the in Section 6.

Equation C.3.

$$\mathbf{WP_{total,\,y} = WP_{in\text{-}use,\,y} + WP_{landfill,\,y}}$$

Where,

$WP_{total,\,y}$	=	Average carbon stored over 100 years from wood harvested in year y (actual or baseline)
$WP_{in\text{-}use,\,y}$	=	Average carbon stored in in-use wood products over 100 years from wood harvested in year y (actual or baseline)
$WP_{landfill,\,y}$	=	Average carbon stored in wood products in landfills over 100 years from wood harvested in year y (actual or baseline)

Appendix D Determination of a Forest Project's Reversal Risk Rating

A reversal risk rating must be determined for the 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.

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. 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 risk ratings will affect only current and future year contributions to the Buffer Account.

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	How 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
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	Default Risk
	Disease/Insects	Loss of project carbon through disease and/or insects	Default Risk
	Other Episodic Catastrophic Events	Loss of project carbon from wind, snow and ice, or flooding events	Default Risk

D.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 that occur on public lands, have lower risk.

Table D.2. Financial Risk Identification

Applies to all projects		
Identification of Risk	**Contribution to Reversal Risk Rating**	
Default Financial Risk	**Forest Project not on public lands or without a Qualified Conservation Easement**	**Forest Project on public lands or with a Qualified Conservation Easement**
	5%	1%

D.2 Management Risk

Management failure is the risk of management activities that directly or indirectly could lead to a reversal. Projects that occur on public lands, or employ a Qualified Conservation Easement 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 D.3. 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 D.4. Risk of Conversion to Alternative Land Use

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
With Qualified Conservation Easement that explicitly encumbers all development rights	0%
Without Qualified Conservation Easement	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 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

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

D.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 Identification

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

D.4 Natural Disturbance Risk

Natural disturbances can pose a significant risk to the permanence of the 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 D.7. Natural Disturbance Risk I – Wildfire

Applies to all projects	
Identification of Risk	**Contribution to Reversal Risk Rating**
United States Default Fire Risk	4%
If fuel treatments have been implemented for the Project Area, reduce the value above by the appropriate Y% as indicated below.*	(4%) x Y%

* 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 D.8. 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 D.9. 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%

D.5 Summarizing the Risk Analysis and Contribution to Buffer Account

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 Category	**Contribution from Risk Descriptions Above**		
	Source	Forest Project without a Qualified Conservation Easement and/or Public Ownership	Forest Projets with a Qualified Conservation Easement and/or Public Ownership
Financial Failure	Default Risk -Remedies for reversals addressed in PIA	5%	1%
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%

Completing the Risk Rating Analysis:

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

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

Appendix E 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 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 E.1.

To determine whether a reforestation project is eligible, perform the following steps:

1. Identify whether site preparation costs[9] 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 Forest Offset Protocol Resources section of ARB's website.
3. Identify the standard Rotation Age for the project's Assessment Area, from the lookup table in 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 productivity in the project's submission form. 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 E.1.

[9] 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 E.1. Determination of Reforestation Project Eligibility

Site Preparation Costs	Value of Harvested Products	Rotation Age (Length)	Site Class	Eligibility	Scenario #
High Site Preparation	High	Short, Medium, Long	Higher	Not Eligible	1
			Lower	Not Eligible	2
		Extremely Long	Higher	Eligible	3
			Lower	Eligible	4
	Medium	Short, 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, Extremely Long	Higher	Eligible	13
			Lower	Eligible	14
	Very Low	Short, Medium, Long, Extremely Long	Higher	Eligible	15
			Lower	Eligible	16
Low Site Preparation	High	Short, Medium	Higher	Not Eligible	17
			Lower	Not Eligible	18
		Long, Extremely Long	Higher	Not Eligible	19
			Lower	Eligible	20
	Medium	Short, 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, Extremely Long	Higher	Eligible	31
			Lower	Eligible	32
	Very Low	Medium, Long, 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

Forest Assessment Areas Introduction

Assessment areas are used to provide standardized regional data for project development. An assessment area is generally defined as a forest vegetation community that shares common environmental, economical, and regulatory attributes. The Forest Offset Protocol Resources section of ARB's website provides data, by assessment area, necessary to calibrate and/or implement project accounting, including:

- Common Practice – The average carbon stocks (metric tons) of the above ground portion of live trees on private lands. The average carbon stock is the result of the suite of management activities within the assessment area. The common practice value is the extent to which improved forest management projects can receive credit for avoided emissions. (See Section 6.2.)
- Diversity Index – The maximum amount (by carbon percentage) of any one native species allowed within a project. (See Section 3.9.2.)
- The rotation length commonly used in the assessment area and the value of harvest for incorporating in a financial test for reforestation projects (see Appendix E).
- The mill efficiency used for calculating wood products (see Appendix C).
- The wood product classes generated for calculating wood products values (see Appendix C).

Defining Assessment Areas

The U.S. Forest Service Forest Inventory and Analysis Program (FIA) is the basis for development of assessment areas. The FIA program collects data on U.S. forests using an extensive array of coordinated sample plots throughout the nation. Together the plots comprise a national inventory system designed to assess the state of U.S. forests on an ongoing basis. The hierarchical and spatial nature of FIA data make it possible to group sample field plots by geographical location. FIA plots are assigned an attribute referred to as 'forest type' that identifies the dominant vegetation present at the plot. Forest Types were combined into forest communities following a process described further below. An assessment area is a forest community within a defined geographical unit. The geographical units are discussed below.

Ecosections are spatial units and can be mapped. The geographical units that contain assessment areas are based on individual ecosections or combined ecosections (called supersections). Supersections were created in order to stratify the plots into high site class and low site class (where possible) and to increase the statistical reliability of the common practice estimates derived for each assessment area. The combination of ecosections into supersectons only occurred where adjacent ecosections share similar environmental, economic, and regulatory attributes. Ecosections are combined into supersections if:

1. The ecosections are adjacent to each other.
2. They share a similar distribution of plots by forest types, which indicates that the ecosections share similar climate, elevation, and other environmental variables.
3. The economics of forest management are similar between the ecosections. The criteria considered to determine economic commonality between ecosections include forest product generation, transportation networks, forest product mill types, and wood products markets. This was based on professional knowledge of regional timber markets.

4. Regulations between ecosections are relatively homogeneous across ecosection boundaries. Ecosections are not combined into supersections in cases where forest practice regulations between adjoining administrative units are known to be markedly different.

The Forest Service computed the statistics for the combined forest types aggregated at the supersection level and disaggregated at the ecosection level. The statistics are reported on a per acre basis and include board foot volume, basal area (square feet), above ground carbon tons, and the sampling error. Ecosections were not combined into supersections if the aggregation changed average standing carbon stocks of any assessment areas by more than 10%, indicating that there are environmental, economic or regulatory differences affecting the forest stocks within these communities.

The aggregation of forest types into forest communities that define assessment areas is based on the natural forest communities found within the ecosections rather than the presence of a single dominant species as in plantation management. As an example, the Northwest Coast Range contains many forest holdings of intensively managed Douglas-fir forests, yet the natural forest community contains many other species such as western hemlock, Sitka spruce, and red alder, among others. The plots used to define the assessment area, as well as the common practice statistic, are the entire set of plots found in the natural forest community. No effort is made to isolate assessment areas based on the existence of plantations. Successional stage, including the presence of shade tolerance species, and management influence on species prevalence is not a basis for stratifying distinct communities. The Forest Offset Protocol Resources data on ARB's webpage displays the associations of forest species (forest types) and assessment areas for all of the ecosections and supersections. Figure F.1 summarizes conceptually the methodology for delineating assessment areas.

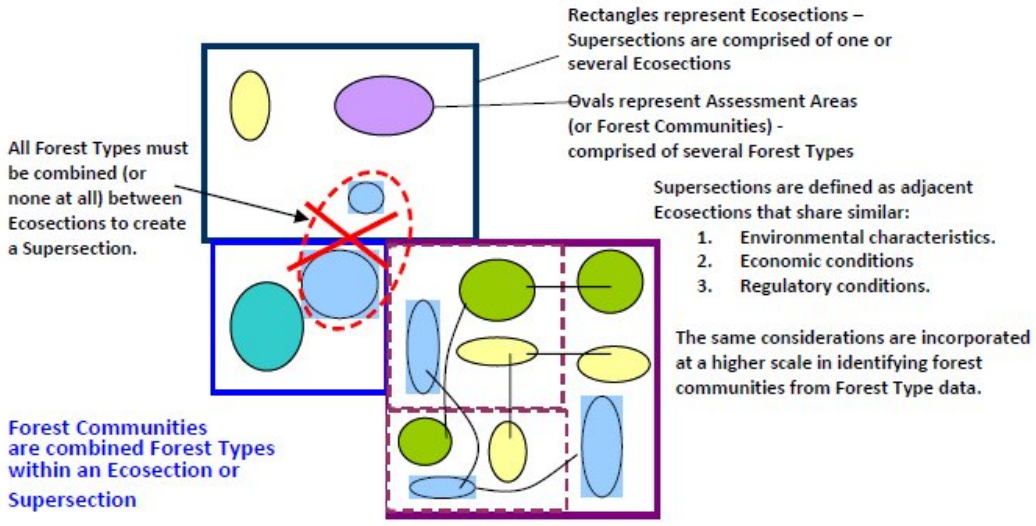


Figure F.1 Schematic of Process to Define Assessment Areas

Determining a Value for Common Practice

The following requirements and methods provide step by step instructions for determining the appropriate Common Practice value for an Improved Forest Management project based on its geographic location and boundaries.

1. **Determine the Geographic Ecosection(s) or Supersection(s) Within Which the Project Area is Located**
   The Offset Project Operator or Authorized Project Designee must determine the geographic Ecosection(s) or Supersection within which the Project Area is located by consulting maps of Supersections. These maps can be downloaded from the Forest Offset Protocol Resources section of ARB's website in either a .pdf format or a Geographical Information System (GIS) shapefile.

2. **Determine the Acreage of the Project Area That Falls Within Each Assessment Area Contained in the Ecosection(s) or Supersection(s)**

   Ecosections and Supersections may consist of one or many Assessment Areas. Assessment Areas are groupings of tree species that are commonly found in association with each other, as in a vegetation community. Assessment Areas are not mapped since the geographic locations of forest communities vary based on highly resolute environmental variables. To determine which Assessment Areas are included within the Project Area, 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 Step 1). Tree species information must be looked up using the most current Assessment Area Data File from the Forest Offset Protocol Resources section of ARB's website. The minimum mapping resolution for vegetation communities is 20 acres. Therefore, any contiguous area 20 acres or greater within the Project Area that consists of a separate vegetation community must be independently mapped.

3. **Where Necessary, Stratify Project Area Acres According to Whether They Are High or Low Site Class**

   The Assessment Area Data File on the Forest Offset Protocol Resources section of ARB's website provides data for each Assessment Area by high, low, or all site classes. For Assessment Areas where data are attributed for high and low site classes, the Offset Project Operator or Authorized Project Designee must further stratify the Project Area and identify the acreage that falls within each site class.

   The computation of the statistics in the Assessment Area Data File (on a per acre basis) for board foot volume, basal area (square feet), and CO_2 equivalent was done for high and low site classes wherever the FIA plots were available in adequate quantity to achieve a sampling error of 18 percent or less. The board foot volume and basal area statistics are presented only to elucidate comparisons to the Common Practice (CO_2 equivalent) statistic. Board foot volume and basal area statistics are not used for other purposes in the protocol.

   For stratification purposes, a "high" site class means a Timber Site I or II (Forest Service Types I, II, and III). A low site class means a Timber Site III, IV, or V (Forest Service Types IV – VII). Landowners must 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. Whatever method is used, documentation of the analysis must be provided to the verifier at the project's initial verification.

4. **Identify the Common Practice Statistic Associated with Each Assessment Area and Site Class Stratum**

   For each Assessment Area and Site Class within the Project Area, identify the appropriate Common Practice statistic from Assessment Area Data File. The value displayed in the Assessment Area Data File indicates CO_2 equivalent metric tons per acre in the above ground portion (bole, bark, top and branches) of live trees.

   If data for an Assessment Area are provided for both high and low site classes, and a 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.

5. **Determine a Value for Common Practice for the Entire Project Area**

   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. See Table F1 for an example.

Table F1. Example of Common Practice Statistic Calculation

Ecosection(s) /Supersection(s)	Assessment Area	Site Class	Acres	Common Practice (Metric Tons CO2-e)
Name the Ecosection(s)/Supersection(s) the project is found within.	*Identify the Assessment Areas the project is in. If the project is in more than one site class for an Assessment Area, enter the Assessment Area twice*	*Enter the Site Class Value*	*Acres for each Assessment Area-Site Class Combination*	*Enter the Value from the most current Assessment Area Data File*
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northeast Conifers	High	1,000	91.8
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northeast Conifers	Low	100	84.4
Adirondacks & Green Mountains	Adirondacks & Green Mountains Northern Hardwood	High	50	102.8
Total Acres / Weighted Average Common Practice			**1,150**	**91.6**