Revised Forest Project Protocol

DRAFT

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Acknowledgements

Staff

Derik Broekhoff	California Climate Action Registry
Heather Raven	California Climate Action Registry
John Nickerson	California Climate Action Registry

Workgroup

Ann Chan	The Pacific Forest Trust
Anton Chiono	The Pacific Forest Trust
Bob Rynearson	Beatty and Associates
Bruce Goines	United States Forest Service
Caryl Hart	California State Parks
Connie Best	The Pacific Forest Trust
Dave Bischel	California Forestry Association
Doug Wickizer	California Department of Forestry and Fire Protection
Ed Murphy	Sierra Pacific Industries
Emily Russell Roy	The Pacific Forest Trust
Eric Holst	Environmental Defense Fund
Florence Daviet	World Resources International
Gary Rynearson	Green Diamond Resources
George Gentry	California Board of Forestry
Greg Giusti	University of California Extension
Jayant Sathaye	University of California, Berkeley
Jeanne Panek	California Air Resources Board
Katie Goslee	Winrock International
Kimberly Todd	United States Environmental Protection Agency
Louis Blumberg	The Nature Conservancy
Mark Nechodom	United States Forest Service
Michelle Passero	The Nature Conservancy
Nick Martin	Winrock International
Robert Hrubes	Scientific Certification Systems
Steve Brink	California Forestry Association
Tim Pearson	Winrock International
Tim Robards	California Department of Forestry and Fire Protection

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Abbreviations and Acronyms

California Registry	California Climate Action Registry
C	carbon
CH_4	methane
CO_2	carbon dioxide
FIA	Forest Inventory Assessment [http://fia.fs.fed.us/program-features/rpa/]
FPP	Forest Project Protocol
GHG	greenhouse gas
GRP	General Reporting Protocol
HFC	hydrofluorocarbon
lb	pound
N_2O	nitrous oxide
PFC	perfluorocarbon
PF	Professional Forester, in the case of California a 'Registered Professional Forester'
Reserve	Climate Action Reserve
RPF	Registered Professional Forester, a person registered to practice professional forestry in California
SF_6	sulfur hexafluoride
USFS	United States Forest Service

1 Introduction

The Forest Project Protocol (FPP) is the Reserve's guide for the design, implementation and registration of forest projects. Only those forest projects that are eligible under and comply with this protocol may be registered with the Reserve.

A separate, but related protocol, the Reserve's Forest Verification Protocol (FVP), provides guidance to approved forest verifiers for conducting verification of project activities and the quantification of GHG emission reductions or removals reported to the Reserve.

1.1 About Forests, Carbon Dioxide and Climate Change

Forests have the capacity to both emit and sequester carbon dioxide, a leading greenhouse gas (GHG) 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 its biomass, i.e. trunk (bole), leaves, branches, and roots. Carbon is also stored in the soils that support the forest (i.e. forest soil), 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, their stored carbon is or may be oxidized or decayed over time releasing CO_2 into the atmosphere. The quantity of CO_2 that is emitted over time may vary, depending on the particular circumstances of the disturbance. Thus, depending on how forests are managed or impacted by natural events, they can be a net source or a net reservoir of CO_2. In other words, they may have a net negative or net positive impact on the climate.

However, through sustainable management and protection, forests can also play a positive and significant role to help address global climate change. The California Climate Action Registry's Forest Protocols are designed to address the forest sector's unique capacity to both store and emit CO_2 and to facilitate the positive role that forests can play to address climate change.

2 Forest-Based GHG Projects

For the purposes of the FPP, a forest project is a planned set of activities to remove, reduce or prevent CO_2 emissions in the atmosphere by conserving and/or increasing forest carbon stocks.

2.1 Eligible Forest Project Types and Definitions

In the future, the Reserve may consider additional project activities that may be reported and verified by the Reserve. At this time, the Reserve will register only the following types of (non-urban) forest project activities.[1]

2.1.1 Reforestation

The establishment and subsequent maintenance of native tree cover on lands that were previously forested but have had less than 10% tree canopy cover for a minimum time of ten years, or have been subject to a significant disturbance within the last ten years that is not the result of intentional or grossly negligent acts of the landowner. This project type may apply to both private and public lands.

[1] Urban forest projects are addressed in a separate protocol and may be downloaded at: http://www.climateregistry.org/tools/protocols/project-protocols.html.

There are two approaches to developing a reforestation project for privately or publicly owned forestlands: 1) following a significant disturbance on a land base that is not a current project that has led to the loss of at least 20% of the project area's forest carbon stocks or 2) following a timeframe whereby the project area has been out of forest cover for at least 10 years. For the purposes of this protocol, "out of forest cover" means less than ten percent (10%) tree canopy cover. In both scenarios, it must be demonstrated that the project area was historically under forest cover.

To be eligible for registration, project developers must provide the following information for reforestation projects:

- An explanation of how the project, at the time of project initiation, meets the eligibility requirements of being out of forest cover for at least ten years; or, due to a significant natural disturbance, the project area has lost at least twenty percent (20%) of its forest carbon stocks[2] that existed before the disturbance.
- An indication that the project area was previously under native forest cover.
- An explanation of why the forest was out of forest cover or a description of the disturbance if a natural significant disturbance occurred.

2.1.2 Improved Forest Management

The management of either private or public lands for commercial or noncommercial harvest and regeneration of native trees when employing natural forest management practices. Natural forest management practices are forest management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple scales from the harvest unit (less than 40 acres) up to the watershed spatial scale (third or fourth order watershed level) approximately 10,000 acres in size.

2.1.3 Avoided Conversion

A project consisting of specific conservation actions to prevent the site-specific clearing and conversion of native forests to a non-forest use, such as agriculture or other commercial development.

2.2 Project Developers

Under this Protocol, a project developer may be a "forest entity", or an independent third party who carries out the design and/or implementation of a forest project on behalf of a forest entity(ies). While a third party project developer may design and implement the forest project, the forest entity(ies) must be identified in project information reported to the Reserve.

A forest entity(ies) must own the trees within the project area in order for the project to be eligible for registration with the Reserve. If multiple forest entities enter into agreement to perform a project on lands with multiple owners, they must designate a single entity to be their representative and report to the Reserve.

[2] Forest carbon stocks refer to the sum of all carbon stocks from the required carbon pools as identified in the Forest Carbon Inventory, Section 9.1.

3 Forest Project Eligibility Criteria

A forest project must meet a specific set of criteria to be eligible for reporting and verification in the Reserve.

3.1 Additionality

The Reserve strives to register only projects that yield GHG reductions that are additional to any that would have occurred in the absence of the Reserve's programs and, more generally, a market for GHG reductions. In other words, creditable GHG reductions must be above and beyond any reductions that would have occurred under "business as usual," where the climate change mitigation benefits of an activity are presumably not considered.

For forest projects, "additionality" is determined by reference to a discrete, forward-looking, quantitative baseline estimate of business-as-usual carbon stocks on lands affected by the project activity. Any net increase in carbon stocks caused by the project activity relative to the baseline will result in creditable GHG reductions under this Protocol. Baseline estimates must reflect legal, physical, and economic factors that influence changes in carbon stocks on project lands over time, as well as management practices that are present on lands with similar environmental conditions within a project's assessment area. The specific requirements for developing an estimate of baseline carbon stocks for each type of eligible project activity are contained in Section 6.

3.2 Project Start Date

The start date a forest project (and its corresponding baseline) is determined by the date on which an eligible project activity (as defined in Section 2.1) begins implementation. Until 12 months after the adoption of the updated protocol, a project developer may list a project that was initiated as early as 2001, pursuant to the criteria listed below. After this period, projects must be listed on the Reserve within 6 months of their initiation date.

Defining the start date for a project

Until 12 months after the adoption of the updated protocol, the Reserve will consider the registration of projects that started as early as 2001, if all the necessary information can be provided to meet the requirements outlined in this Section, as well as the rest of the Protocol. Project baseline data for each consecutive year following the commencement of the project activity must be reported to the Reserve and verified.

Initiating a new project in an area where a previous project was terminated

A new GHG project may be initiated in the same area as a previously terminated GHG project as long as any reversal of GHG reductions from the former project have been completely compensated for through the Reserve's buffer pool or alternatively through a third-party insurance mechanism (see Section 7). The start date for the new project will be determined by when the new project activity commences.

3.3 Project Implementation Agreement

To be eligible, each project is required to enter into a Project Implementation Agreement with the California Registry. The Project Implementation Agreement is an agreement between the Reserve and a landowner setting forth: (i) the landowner's obligation (and the obligation of its successors and assigns) to comply with the forest project protocol established by the Reserve for a term of 100 years, and (ii) the rights and remedies of the Reserve in the event of any failure of landowner to comply with those obligations.

The agreement must be recorded and is binding on the successors and assigns of the landowner. The agreement must be recorded with the project in the county where the project exists that identifies the contract. If a conservation easement is used in addition to the Project Implementation Agreement, the conservation easement must be recorded within a year of the project's listing as a demonstration that any limits to forest management defined in the conservation easement are intended to support the project activity. Otherwise the limits described in the conservation easement must be considered as a legal restriction in the baseline analysis.

Public lands are exempt from the need to record the agreement or provide recorded notice since the risks of land transfers to private parties is extremely low or is done in a very open and transparent process. In the specific case of an "Avoided Conversion" project type the protocol requires the use of a conservation easement or transfer to public ownership.

3.4 Project Location

All forestry-based GHG projects located on public or private lands in the United States of America are eligible to register with the Reserve, provided they meet all other eligibility requirements described in this section. The methods required by this Protocol for estimating baseline carbon stocks for forestry projects cannot currently be applied outside the United States, as they rely on U.S.-specific data sets and models.

3.5 Use of Native Species and Natural Forest Management Practices

Forest projects can create both long-term climate benefits and provide other environmental benefits. This Protocol applies to project activities that achieve not only climate benefits, but also will improve and/or sustain natural ecosystem processes. All forest projects must promote and maintain native species and utilize natural forest management, as described below.

3.5.1 Promotion and Maintenance of Native Species

All forest projects are required to promote and maintain forest types that are native to the project area. 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. Appendix D provides required references by State for the determination of defining native forests. If a state/regional reference is unavailable, the project developer shall provide documentation from a State Botanist that the project meets the definition above.

Forest projects, irrespective of project type, shall incorporate natural forest management. This protocol provides a worksheet (Table 3.1) to determine if the project meets the definition of natural forest management. Natural forest management is defined as management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple scales from the harvest unit (less than 40 acres) up to the watershed spatial scale (third or fourth order watershed level) approximately 10,000 acres in size. The following key requirements shall apply to projects regardless of the silvicultural or regeneration methods used to manage or maintain the forest:

- Maintain tree species composition and distribution consistent with the forest type and forest soils native to the assessment area.
- Maintain hydrologic patterns and functions to support functional habitat for endemic plant and wildlife species.

- Manage the distribution of habitat/age classes and structural elements to support functional habitat for endemic plant and wildlife species.

Projects that initially meet the natural forest management requirement will maintain this requirement over the course of the project life. Projects that do not initially meet the natural forest management requirement must do so prior to being able to verify reductions.

The following evaluation must be completed and verified at the project’s initiation and at each subsequent verification cycle for all projects. Reforestation projects that have no immediate intent to harvest trees (within 2 years) do not have to achieve the same score for habitat features and therefore may meet the Natural Forest Management Requirements with a lower score. All projects must use the evaluation criteria for Improved Forest Management whenever commercial harvested is incorporated into the project management. Projects that do not promote and maintain native trees or do not practice Natural Forest Management are not eligible for registration with the Reserve.

Table 3.1. Evaluation criteria to test if a forest project meets the requirement for the promotion and maintenance of native species and natural forest management.

Native Species – Presence and Composition					
Indicator	**Score**				**Enter Value**
	0	**1**	**2**	**3**	
Are only native tree species being cultivated and/or managed in the project area?	< 80% native trees in project area	>75% native species in project area and project guidance is to reduce non-native species	>95% native species in project area and project guidance is to reduce non native species		
Is the composition and distribution of tree species consistent with forest types native to the project area?	No diversity of species exists.	Management of species distribution appears to favor commercial species over background (unmanaged) levels by a factor of 75%	Management of species distribution appears to favor commercial species over background (unmanaged) levels by a factor of 25%	Management of species distribution appears to represent background (unmanaged) levels.	
				Sum of Native Trees Value	

Functional Habitat Elements for Endemic Plant and Wildlife					
Indicator	**Score**				**Enter Value**
	0	**1**	**2**	**3**	
Percentage of area in mature (within 80% of culmination of mean annual increment for biomass) age classes across project area	<5%	5% - 10%	10%-15%	>15%	
Structur — Snags (at least 16” DBH and 10’) Large old trees (beyond	Verifier during verification cycles	Verifier during verification cycles defined by protocols	Verifier during verification cycles	Verifier during verification cycles defined by protocols	

	culmination of mean annual increment) Den and mast-producing trees Large woody debris (at least 10" diameter and 20' in length)	defined by protocols determines that these features are not ecologically appropriate in numbers and distribution	determines that these features are not ecologically appropriate in numbers and distribution	defined by protocols determines that these features are not ecologically appropriate in numbers and distribution	determines that these features are not ecologically appropriate in numbers and distribution	
Sum of Functional Habitat Elements for Endemic Plant and Wildlife						

Sensitive Areas on Forests

Indicator	Score				Enter Value
	0	1	2	3	
Protection zones around watercourses & wetlands	No regulations/ self-regulated policies exist	Internal policies* exist and implementation of policy is verifiable	Regulations exist with oversight		
Limitations on site disturbance in areas prone to surface erosion, compaction or landslides	No regulations/ self-regulated policies exist	Internal policies* exist and implementation of policy is verifiable	Regulations exist with oversight		
Maintenance of habitat (structure and composition) for endemic wildlife species	No regulations/ self-regulated policies exist	Internal policies* exist and implementation of policy is verifiable	Regulations exist with oversight		
Maintenance of habitat (structure and composition) for State and Federal threatened and endangered endemic species	No regulations/ self-regulated policies exist	Internal policies* exist and implementation of policy is verifiable	Regulations exist with oversight		
Sum of Sensitive Areas in Forests					

Third Party Oversight of Management Activities

Indicator	Score				Enter Value
	0	1	2	3	
Is the project area within the scope of a forest management verification issued under the endorsement of the FSC, CSA, SFI or an affiliated organization (e.g.,	No	Yes			

ATF)?					
Are activities in the project area subject to an assessment of environmental impacts prior to site disturbance (such as timber harvest) whereby management activities are identified that fully mitigate the impacts?	No	Yes			
Sum of Third Party Oversight of Management Activities					
Sum of Native Trees Value					
Sum of Functional Habitat Elements for Endemic Plant and Wildlife					
Sum of Sensitive Areas in Forests					
Sum of Third Party Oversight of Management Activities					
Sum of all Categories					

Summary				
	Native Species Test		**Natural Forest Management Test**	
Theme	**Sum of Native Trees–Presence and Composition (from above)**		**Sum of Functional Habitat Elements for Endemic Plant and Wildlife, Sensitive Areas in Forests, and Sum of Third Party Oversight (from above)**	
Project Score	<2	>= 2	< 5	>=5
Reforestation	Does not Meet the Promotion and Maintenance of Native Species. The project does not meet the minimum criteria. The project must meet the Native Species requirement prior to having verified reductions.	Meets the Promotion and Maintenance of Native Species	Meets Natural Forest Management Requirements	
Improved Forest Management and Avoided Conversion			Project does not meet Natural Forest Management Requirements- Project must meet Natural Forest Management requirements prior to having verifiable reductions	Meets Natural Forest Management Requirements
* A monitoring plan must be developed and adhered to that demonstrates consistent progress toward policies.				

3.5.2 Promotion of On-Site Forest Carbon Stocks

In an effort to promote and maintain the environmental integrity of forest projects, the Reserve has developed a monitoring strategy for projects to ensure that the live tree portion of a project's carbon stocks is maintained and/or increased during the project life.

Reductions shall not be registered where a decrease in the standing live pool cannot be attributed to one of the following conditions:

1. The decrease is necessary to improve resilience amidst wildfire, insect, or disease risks. The project proponent must explain and justify the risks and the actions to reduce the risks.
2. The decrease is conducted as part of balancing structural classes (regeneration, sub-merchantable, and merchantable) in the development of a sustainable management plan. The projected project activity stocks provided at the project's registration must demonstrate that the balancing was planned.
3. The decrease is part of normal silviculture cycles (for forest ownerships less than 1000 acres). The projected project activity stocks provided at the project's registration must demonstrate that the silviculture activity was planned.
4. The decrease is part of a non-harvest disturbance.

4 Identifying a Forest Project's Geographic Boundary

The geographic boundary of a forest project must be defined at the time the project is listed. This shall be conducted using a map that displays public and private roads, major watercourses, topography, towns, and public land survey Townships, Ranges, and Sections. The project can be contiguous or separated into tracts. For improved forest management projects, the geographic area cannot extend beyond the boundaries of an assessment area (see Glossary). An improved forest management project that involves activities in multiple assessment areas must be submitted as a series of separate projects (one project for each assessment area).

5 Defining a Forest Project's GHG Assessment Boundary

Project-level reporting in this protocol addresses forest carbon stocks and biological CO_2 emissions. The reporting of all other types of GHGs, as identified by the Kyoto Protocol,[3] is optional for forest projects at this time.

The "primary" (intended) effect[4] of forestry-based GHG projects will be either a net increase in forest carbon stocks due to increased removals of CO_2 from the atmosphere (reforestation and forest management projects), or a net reduction in CO_2 emissions from harvesting, clearing, or other disturbance of forest carbon stocks (forest management and avoided conversion projects). Forest projects may also have secondary (unintended) effects on GHG emissions, including CO_2 emissions associated with site preparation, planting, and maintenance activities, as well as CO_2 emissions from tree harvesting displaced by the project to other forest sites (often referred to as "leakage"). Table 5.1 provides a comprehensive list of all GHG source, sinks, and reservoirs that must be included in the GHG assessment boundary for forestry projects, grouped according to whether they are associated with primary or secondary effects.

[3] The six GHGs identified by the Kyoto Protocol are: carbon dioxide, nitrous oxide, methane, hydroflourocarbons, perflourocarbons, and sulphur hexafluoride.
[4] The terms "primary effect" and "secondary effect" come from WRI/WBCSD 2005. The Greenhouse Gas Protocol for Project Accounting, World Resources Institute, Washington, DC, Chapter 5. Available at http://www.ghgprotocol.org.

Table 5.1. GHG sources, sinks, and reservoirs (SSRs) included in the forestry project GHG assessment boundary.

GHG SSR Category	GHG SSR	Type	Associated GHGs	Included in GHG Assessment Boundary?
Related to Project's Primary Effect				
Living Biomass	Above-ground living biomass	Reservoir	CO_2	Yes
	Below-ground living biomass	Reservoir	CO_2	Yes*
	Shrubs and herbaceous understory	Reservoir	CO_2	Yes*
Onsite Dead Biomass	Standing dead biomass	Reservoir	CO_2	Yes*
	Lying dead wood	Reservoir	CO_2	Yes*
	Litter	Reservoir	CO_2	Yes*
Soil	Soil	Reservoir	CO_2	Yes*
Off-Site Dead Biomass	Wood products	Reservoir	CO_2	Yes*
Related to Project's Secondary Effects				
One-Time Secondary Effects				
Site preparation	Vehicle and equipment operation	Source	CO_2	Yes
Other??				
Upstream and Downstream Secondary Effects				
Maintenance Activities	Vehicle and equipment operation	Source	CO_2	No
Timber Harvesting	Harvesting of off-site forests	Source	CO_2	Yes
Transportation of wood products	Vehicle operation	Source	CO_2	No

* May be excluded only if the cumulative GHG emissions from all excluded SSRs over the project lifetime are projected to be less than 5% of total quantified GHG reductions/removals.

5.1 Accounting for Significant Secondary Effects (Leakage)

Projects are required to account for any leakage that is determined to result from its activity. Leakage is an increase in greenhouse gas emissions in sequestration caused by a project outside of its geographic boundaries.

Leakage is difficult to measure on a project basis. This protocol requires the use of methods that address the risk of leakage for each project type and result in an estimate of leakage that is deducted from GHG reductions (See Section 6). An added methodology that flags potential onsite activity-shifting is included for all forest projects based on tracking harvest data and or conversion data for entities that have projects on a portion of their total forest land ownership.

6 Quantifying GHG Emission Reductions and Removal Enhancements

This Section provides guidance to project developers/forest entities to develop and forecast project baselines and activities, quantify risk related to leakage, and finally calculate greenhouse gas reductions. It also provides guidance for monitoring project performance over time. Baseline projections require the development of a forest project carbon inventory, requirements and guidance for which are contained in Appendix A. The baseline for each project type must be forecasted using the requirements and guidance below and the modeling guidance in Appendix B.

6.1 Reforestation Projects

6.1.1 Primary Effect – Estimating On-Site Baseline Carbon Stocks

Reforestation projects must demonstrate that under baseline circumstances, the project area would remain out of forest cover for at least the next 10 years. The qualitative characterization of the baseline must provide an assessment of the likely vegetative conditions, amidst a likely set of conditions and activities that would develop in the absence of the project, taking into consideration any mandatory statutes or regulations that would encourage or require reforestation at the project site.

To quantify the reforestation baseline, the current inventory (carbon stocks) is determined at the project's initiation, using the inventory methodology set out in Appendix A of this protocol.[5] The project developer shall perform a computer simulation that simulates the characterization of the conditions and activities that would develop in absence of the project, following the guidance in Appendix B.

The baseline characterization of a reforestation project following a significant disturbance must include the conversion of standing dead material to wood products to the extent similar removals have occurred within the project's assessment area. An exception may be justified where the conversion to wood products can be shown to be economically infeasible based on analysis of stumpage values by species and haul cost.

Required Modeling Procedures

TBD

6.1.2 Secondary Effects – Quantifying Net Changes at Other Affected GHG Sources

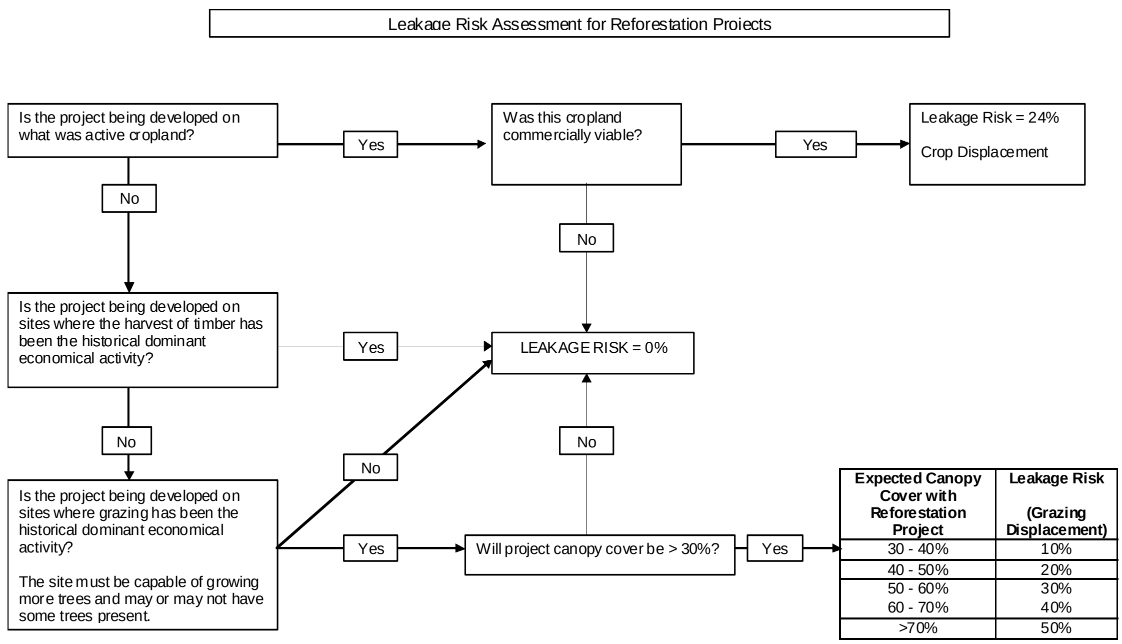
For reforestation, onsite activity-shifting leakage can occur when activities to plant trees shift agriculture pressure or grazing pressure and result in the removal of trees elsewhere within the entity. Reforestation project developers must account for leakage pursuant to the guidance in this section which includes an assessment for the displacement of commercially viable cropland or sites where grazing has been the historically dominant activity.

Increases in emissions associated with machinery use in site preparation for reforestation and restoration project activities as well as some rehabilitation activities associated with forest management projects must also be accounted for. This should be done, following the guidance

[5] Please note that reforestation initial stocks could be zero if the area has no forest cover or carbon pools that can be quantified.

in Chapter 7 "Direct Emissions from Mobile Combustion" of California Climate Action Registry's General Reporting Protocol. Project proponents will need information about types of vehicles utilized in the project, where they are registered, fuel consumption and miles traveled for each type of vehicle. Fuel consumption data may be obtained from bulk fuel purchases, fuel receipts, or direct measurements of fuel use, such as official logs of vehicle fuel gauges or storage tanks. Sources of annual mileage data could include: odometer readings, trip manifests that include mileage to destinations, hours of operation, or maintenance records.

Project proponents must account for any of the following categories applicable to the project: carbon dioxide emissions from mobile combustion, methane and nitrous oxide emissions from mobile combustion, emissions from off-road vehicles or construction equipment, and carbon emissions from biodiesel. Specific methodologies for these calculations and examples can be found in Chapter 7 of the General Reporting Protocol at
http://www.climateregistry.org/resources/docs/protocols/grp/GRP_V3_April2008_FINAL.pdf



Assumptions:

- Leakage risk for cropland displacement is based on a default rate developed by Murray et al (*Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture,* USEPA, 2005). Rates are regionally dependent so this would need to be adjusted if projects are occurring outside of CA.
- If canopy cover associated with the reforestation project in < 30%, grazing activity will not be affected.
- With increasing canopy cover, competition among grazers increases and, therefore, total grazing on the project land decreases and is displaced.
- Demand for crops is inelastic.
- "Commercially viable" is defined here as profitable either without subsidies or with a reliable, long-termed sustained form of subsidies.

For reforestation, onsite activity-shifting leakage can occur when activities to plant trees shift grazing pressure or agriculture pressure and result in the removal of trees elsewhere within the entity. As an added assessment of leakage, project proponents are required to provide an annual estimate of the entity acres by general forest cover type. This will provide a trend of forest acres over time (Table 6.1).

Table 6.1. Example of tracking cover by general forest cover.

Year	Attribute	Entity Acres
X	Forest	
	Other	
	Entity Acres	

A decrease of forest acres greater than 5% serves as an indication leakage is occurring. Converted acres that exceed this figure must be multiplied by the project's average carbon stocks which serves an onsite activity-shifting leakage estimate unless the project developer can explain and justify (and the verifier verify) the following conditions led to the calculation of the increase:

- *Improved Accuracy in Vegetation Mapping*

  Efforts that improve accuracy in vegetation mapping may result in forest cover estimates greater than 5%. The project proponent will need to demonstrate where these adjustments are occurring and have verified by the verifier

- *Natural Disturbances*

  Fires, disease, and pests are examples of agents that reduce forest carbon stocks and are often beyond the control of humans. While not the result of activity-shifting leakage, the occurrence of such instances may play a role in reducing entity carbon stocks.

6.2 Improved Forest Management Projects

6.2.1 Primary Effect – Estimating On-Site Baseline Carbon Stocks

6.2.1.1 Private Forest Lands

For projects on private forest lands, the requirements of this section must be followed to develop a representation of baseline stock changes, taking into consideration legal requirements in the relevant jurisdiction, economic feasibility, and forest property conditions. The approach is based on a computer simulation of inventory stocks at the project's initiation taking into consideration legal requirements, economic feasibility, recent trends in inventory levels, and management activities present on similar landscapes within the assessment area.

All improved forest management project activities are analyzed in reference to the average stocks of the live standing carbon pool from within the project's assessment. The average stocks are derived from the USDA Forest Service Forest Inventory and Analysis program or "FIA" and referred to as the applicable mean. Baseline projections must be subject to constraints, including the legal requirements of the relevant jurisdiction as applied to the project area, the economic feasibility of the management activities, and the physical feasibility of the activities.

There are additional constraints, described below, that depend on the initial forest inventory to ensure conservative calculations.

1. Forests with above-average stocks and forests and forests with below-average stocks have different baseline projections based on programmatically assessing common management behavior.
2. For forests with above-average stocks, the modeled baseline activity cannot deplete stocks below the landscape average established by Reserve, even if such activity might be legal and feasible.
3. For forests with below-average stocks, the average stocks for the baseline activity cannot fall below the initial stocks.

Estimating the Baseline

The project proponent must establish a 100 year model of forest stock changes, beginning with the inventoried stocks at the time of project initiation. This baseline incorporates an initial analysis of the standing live carbon pool (living trees) and is modified by subsequently adding additional pools, if required, using the inventory methodology from Appendix A.

The baseline must reflect all applicable legal requirements:

Baseline stock changes must be modeled pursuant to all applicable laws, regulations, and permanent legally-binding commitments in effect at the project site at the time of project initiation. Within these legal constraints the management scenario must maximize timber values as determined by growth and yield analysis. These legal constraints include:

1. Federal, state/provincial, local government regulations that might reasonably be assumed 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, and c) minimum stocking standards.
2. In the absence of applicable forest practice rules, applicable Best Management Practices established by federal, state, provincial or local government that relate to forest management must be included in the characterization.
3. Other legally binding and irreversible 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.
    a. Previously existing legally binding and irreversible requirements are accepted if they were put in place after the historical initiation dates as identified in Section 3.2.
    b. The modeled baseline projection need <u>not</u> take into consideration voluntary reversible agreements including, but not limited to, voluntary constraints included in Habitat Conservation Plans, Safe Harbor Agreements, and rental contracts.

The baseline approach must meet all physical and financial limitations:

In addition to the incorporation of compliance with all legally binding obligations, modeled stock changes shall also be physically possible and financially feasible. This means that any assumption of harvest in a baseline approach must be able to occur from a physical and biological perspective as well as a financial perspective pursuant to current conditions.

A landowner shall demonstrate that the baseline is financially and physically feasible through one of the following mechanisms:

1. A financial analysis of the baseline activity that captures the relevant costs and returns for the baseline scenario, taking into consideration all legal, physical, and biological

constraints, with reference to regional norms or demonstration of actual costs and returns on the subject property or other properties in the assessment area (see Appendix C for more information regarding assessment area).

2. Identification of activities similar to the proposed activities in the baseline within the past 15 years in the assessment area undertaken on the subject property or on properties with similar legal, physical and biological conditions.

Additional constraints:

Additional constraints must be applied to baseline projections to foster conservative estimates. These additional baseline constraints are as follows:

1. *For projects whose initial project inventories exceed the applicable mean (as defined in Section 10) for standing live carbon within the assessment area:* The modeled standing live carbon stocks cannot go below the higher of:
    a. the applicable assessment area mean of standing live carbon stocks, or
    b. the lowest level allowed by regulatory, physical, or economic constraints.

2. *For projects whose initial project inventories are below the applicable mean*: The modeled standing live carbon stocks cannot go below the higher of:
    a. carbon in the current standing live stocks, or
    b. the lowest level allowed by regulatory, physical, or economic constraints.

    In addition, projects whose initial project inventories are below the applicable mean must document any changes in the project area's inventory over the preceding 10 years. Initial baseline levels of standing live carbon stocks must be modeled as the higher of:
    a. the project area's initial inventory of standing live carbon stocks, or
    b. 80% of the highest inventory levels documented for the preceding 10 year period.

Required Modeling Procedures

TBD

6.2.1.2 Public Lands Improved Forest Management Baseline

The baseline for improved forest management projects on public lands must be based on a projection into the future based on historical trends. Assumptions are developed as to how the past activities are likely to be continued into the future, which leads to model projections of current forest stocks incorporating these assumptions.

For lands owned or controlled by public agencies, the baseline qualitative characterization shall reflect common forest management practice for the agency and agency project area (harvest retention standards, rotations, and other practices that significantly affect carbon stocks) determined by applicable statutes, regulations, policies, plans and activity-based funding over the past ten years. The subsequent quantification of the baseline projection shall use a current inventory estimate and project it into the future for the life of the project based on this qualitative characterization. In the event that such statutes, regulations, policies, budgets, and plans have changed to materially affect the project carbon over the past ten years, the policies outcomes that lead to the most conservative baseline carbon estimates should be used.

To quantify the baseline approach, the current inventory (carbon stocks) is estimated at the project's initiation, using the inventory methodology set out in Appendix A of this document. A review of inventory trends over the past ten years must be assessed and evaluated in terms of how statutes, regulations, policies, plans, and activity-based funding influenced the inventory to bring it to the current condition. The project proponent shall develop and model a scenario that reflects future inventory trends by demonstrating how the statutes, regulations, policies, plans, and activity-based funding are likely to influence the inventory in the future.

6.2.2 Secondary Effects – Quantifying Net Changes at Other Affected GHG Sources

Improved forest management project developers must demonstrate account for leakage pursuant to the guidance in this section.

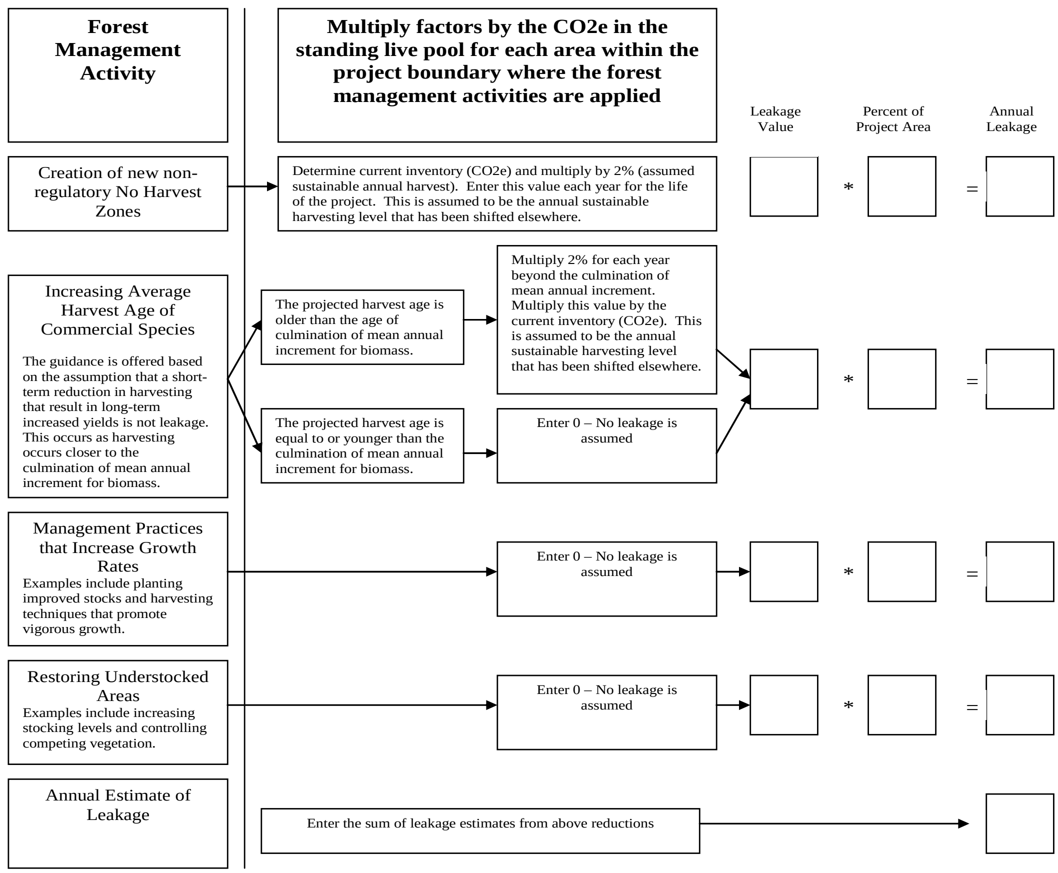
Increases in emissions associated with machinery use in site preparation for reforestation and restoration project activities as well as some rehabilitation activities associated with forest management projects must also be accounted for. This should be done following the guidance in Chapter 7 “Direct Emissions from Mobile Combustion” of California Climate Action Registry's General Reporting Protocol. Project proponents will need information about types of vehicles utilized in the project, where they are registered, fuel consumption and miles traveled for each type of vehicle. Fuel consumption data may be obtained from bulk fuel purchases, fuel receipts, or direct measurements of fuel use, such as official logs of vehicle fuel gauges or storage tanks. Sources of annual mileage data could include: odometer readings, trip manifests that include mileage to destinations, hours of operation, or maintenance records.

Project proponents must account for any of the following categories applicable to the project: carbon dioxide emissions from mobile combustion, methane and nitrous oxide emissions from mobile combustion, emissions from off-road vehicles or construction equipment, and carbon emissions from biodiesel. Specific methodologies for these calculations and examples can be found in Chapter 7 of the General Reporting Protocol at http://www.climateregistry.org/resources/docs/protocols/grp/GRP_V3_April2008_FINAL.pdf

Leakage Risk Assessment for Improved Forest Management Projects

The worksheet below is based on the following assumptions:

1. Improved forest management projects are on land bases that have historical and projected future patterns of harvesting biomass for direct or indirect economic activities. That is, changes in management activity could represent a decrease in supply.
2. Demand of wood products is inelastic in relationship to supply (Murray et al, date).
3. A harvest level of two percent of inventory (board feet) is used as a standard that could be managed sustainably and lead to a high level of carbon stocking. It is a conservative standard (forests typically have growth rates that exceed 2% at high levels of sustainable growth) which addresses issues of demand inelasticity.
4. The theoretical optimal carbon stocking on managed forestlands occurs when harvest takes place at the point that biomass accumulation in a stand begins to decline.
5. Leakage is measured as a shift of harvest activities or as a shift to substituted products over a temporal scale. A short term reduction in harvest that leads to increased production (i.e. harvesting closer to the mean annual increment for biomass) over a longer term does not constitute leakage as overall productivity is increased over a temporal scale.
6. Biomass in this instance refers to standing live tree carbon.



Commercial forest management projects that constitute more than 10% and less than 90% of the entity's area are required to submit inventory estimates for the entity and harvest data as part of the project annual report. This data will be held in a confidential location where only the verifier can access the data. A harvest volume increase of 0.5% within the entity outside the project area over a 10-year running average relative to the entity's inventory will serve as an indication that onsite activity-shifting leakage could be occurring. Harvest volumes that exceed this figure are calculated as onsite activity-shifting leakage unless the project developer can explain and justify (and the verifier verify) the following conditions led to the calculation of the increase:

- *Inventory Updates*

  The forest protocols allow the use of plot data from sampling activities to be used if the sampling activity was performed within the last ten years. Sampling activities are likely to be an ongoing activity for most forest landowners. Sampling activities may take place to replace retired plot data or to increase or decrease the confidence in the inventory estimate. Adding plots may alter the original inventory estimate, even after adjusting the original estimate for growth. Since inventory estimates are typically in the order of +/- 10%, the degree of change will depend on the level of confidence that existed in the original inventory estimate. Additional plot data will have less of an effect with an inventory that has a high level of confidence than one that has a low level of confidence.

- *Natural Disturbances*

  Fires, disease, and pests are examples of agents that reduce forest carbon stocks and are often beyond the control of humans. While not the result of activity-shifting leakage, the occurrence of such instances may play a role in reducing entity carbon stocks.

6.3 Avoided Conversion Projects

6.3.1 Primary Effect – Estimating On-Site Baseline Carbon Stocks

There are two approaches for estimating the baseline for an avoided conversion project:

1. Specific analysis that verifies an immediate threat of conversion for the project site and demonstrates the project site would, in the absence of the avoided conversion project, convert to another use within five years of project initiation.

2. Assessment of the risk of conversion in the project area with analysis of the likelihood of conversion based on economic, geographic and political factors.

The presumption in the first scenario is the site-specific immediate threat would result in conversion in the absence of the project. The presumption underlying the second baseline approach is that conversion of the forest area to a non-forest use would happen in the near term in accordance with the risks, as identified by the worksheet below. As a project proponent, you may choose either approach to characterize your baseline.

Only project areas that do not have current legal restrictions that disallow conversion activities (e.g. deed restrictions and conservation easements) and project areas that are on private land are eligible to use this baseline methodology.

6.3.1.1 Baseline Characterization for Immediate Site-Specific Threat of Conversion

If the identified project baseline is an immediate site-specific threat of conversion, it shall be characterized and supported by the conditions identified below. Please note that an appraisal prepared by a qualified appraiser (as defined by IRS code 170(f)(11)) may be substituted for one or more of conditions 1 – 4 below to the extent the appraisal addresses them, while providing supplementary documentation for the conditions that are not addressed in the appraisal.

Suitability of Project Area for Conversion

Provide a clear description of the specific type of conversion that would take place on the project property and how the land is suitable in location and physical characteristics for the land use to which it would be converted in the absence of the project.

Legal Permissibility of Conversion

Provide documentation to establish that the current land use policies, including zoning and general plan ordinances, and other local and state statutes and regulations permit the proposed type of conversion; or provide documentation that the project proponent has obtained all necessary approvals from the governing County to convert the project property to the proposed type of conversion (including, for instance, certificates of compliance, subdivision approvals, timber conversion permits, other rezoning, major or minor use permits, etc.). In the case where existing ordinances, statutes, and regulations provide a process for ministerial or discretionary approval of the proposed conversion, the project proponent must demonstrate that not only is it legal, but also that it is economically and politically feasible to obtain all ministerial and/or discretionary approvals necessary to proceed with the proposed conversion within five years of the project initiation.

Disparity in Value

Provide documentation, such as an appraisal or a bona fide offer to purchase the property, to demonstrate that the current fair market value of the proposed conversion for the project area is significantly greater (at least 25%) than the current land use value.

Estimated rate and effect of conversion for the project area

Provide a description of the impact of the proposed conversion in terms of the rate and quantity of forest carbon removal. If the proposed conversion does not result in complete removal of forest carbon, it should be assumed that remaining forested areas will continue to grow naturally without human or natural disturbance. The rate and quantity of forest carbon removal from the hypothetical conversion should be substantiated with one of the following:

- Documentation that the proposed rate and quantity of forest carbon removal from the project area is consistent with similar conversions on lands of similar physical and political characteristics in the local region that have occurred within the last five years.
- Documentation provided by knowledgeable experts (such as real estate professionals) or decision-makers (such as county planning directors) that there is a demonstrated trend of conversion on other properties where the conversion footprint and rate are similar (i.e. extent and volume of tree removal over time) to that anticipated in the project area.

6.3.1.2 Baseline Characterization for Avoided Conversion Baseline, Based on Risk of Conversion

Suitability of Project Area for Conversion

Provide a clear description of the specific type of conversion that would take place on the project property and how the land is suitable in location and physical characteristics for the land use to which it would be converted in the absence of the project.

Legal Permissibility of Conversion

Provide documentation to establish that the probable conversion, based on the risk assessment below, is not illegal and that it is feasible economically and politically to obtain necessary approval and permits.

Disparity in Value

Provide documentation, such as an appraisal or a bona fide offer to purchase the property, to demonstrate that the current fair market value of the proposed conversion for the project area is significantly greater (at least 25%) than the current land use value.

Assessment of Risk of Conversion

The risk of conversion of any project area to 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, zoning, and quality of access to the project area. High values for alternative uses for the land may compete with current land use and lead to a change in land use that impacts carbon stocks.

The table below provides the methodology to be used to compute an index that represents the risk of conversion to other uses based on individual attributes. The project area must be evaluated for each of the attributes listed in the top row. A risk ranking is determined by adding the sum of the points for the project area.

Table 6.2. Risk of conversion.

Conversion Rank	Topography	Proximity to population center	Proximity to Local Provisions (Groceries, fuel, supplies)	Population Growth in Area with 5 Hours Drive Time	Costs of Services (electricity, water)	Seasonal Access	Zoning
Highly Likely (2 points each)	0-30% slope	< 3 hours to a population > 500,000	< 30 minutes	Increasing	Developed at < 9.9% of land value	Year-round	Not restrictive to conversion
Moderate Likely (1 point each)	30-45% slope	< 3 hours to a population > 50,000	30 – 60 minutes	Stable	Developed at 10% to 49.9% of land value	3 Seasons	Somewhat restrictive to conversion
Not Likely (0 points)	>45% slope	> 3 hours from a population > 50,000	> 60 minutes	Decreasing	Developed at > 50% of land value	1-2 Seasons	Very restrictive to conversion

The project area is assigned a discount value that is applied to the project's calculated emissions reductions to account for the uncertainty related to the timing of the conversion event.

Table 6.3. Conversion uncertainty.

Score (from matrix above)	Conversion Uncertainty Discount Applied to Analysis of Reductions
14	40%
13	50%
12	60%
<12	Not Eligible

Due Diligence

In addition to using the chart, the project developer must perform some due diligence to demonstrate a trend of similar conversion in the county. Documentation shall be provided to demonstrate that there is at least one other area, of similar physical characteristics, that has recently been (within last 5 years) or will be converted from forest to the anticipated conversion. This documentation may be provided by knowledgeable experts (such as real estate professionals) or decision-makers (such as county planning directors).

Estimated Rate and Effect of Conversion for the Project Area

As with the site-specific immediate threat baseline approach, an assessment must be conducted to qualify the anticipated impacts to carbon stocks of the hypothetical conversion (i.e. identify total removal of carbon stocks by the anticipated conversion). Since the timing of the event is unknown, the conversion is assumed to take place over ten years, starting at the project's initiation, and incorporating the discount value from the table above, as applied to the estimated reductions. The estimated reductions are generated by analyzing the impacts of the most likely conversion scenario and amortizing them over the ten year period. For example, if the total estimated conversion project reductions total 500,000 tons CO2e and the Uncertainty Discount Factor is 60%, the estimated reductions over a ten-year period would be 20,000 tons CO2e per year.

(500,000 tons CO2e **X (1- 60%** Uncertainty Discount**))/10** years **= 20,000** tons CO2e per year

If the hypothetical conversion does not result in complete removal of forest carbon, the remaining forest carbon after the ten year amortization shall be held constant in the baseline for the project life.

The quantity of forest carbon removal from the hypothetical conversion should be substantiated by providing documentation that the proposed quantity of forest carbon removal from the project area is consistent with similar conversions on lands of similar physical and political characteristics in the local region that have occurred within the last five years.

6.3.2 Secondary Effects – Quantifying Net Changes at Other Affected GHG Sources

Avoided conversion project developers must demonstrate account for leakage pursuant to the guidance in this section.

Increases in emissions associated with machinery use in site preparation for reforestation and restoration project activities as well as some rehabilitation activities associated with forest management projects must also be accounted for. This should be done, following the guidance in Chapter 7 "Direct Emissions from Mobile Combustion" of California Climate Action Registry's General Reporting Protocol. Project developers will need information about types of vehicles utilized in the project, where they are registered, fuel consumption and miles traveled for each type of vehicle. Fuel consumption data may be obtained from bulk fuel purchases, fuel receipts, or direct measurements of fuel use, such as official logs of vehicle fuel gauges or storage tanks. Sources of annual mileage data could include: odometer readings, trip manifests that include mileage to destinations, hours of operation, or maintenance records. Project developers must account for any of the following categories applicable to the project: carbon dioxide emissions from mobile combustion, methane and nitrous oxide emissions from mobile combustion, emissions from off-road vehicles or construction equipment, and carbon emissions from biodiesel. Specific methodologies for these calculations and examples can be found in Chapter 7 of the General Reporting Protocol at http://www.climateregistry.org/resources/docs/protocols/grp/GRP_V3_April2008_FINAL.pdf.

Project proponents must use the table below, developed using data from the Land Cover mapping and Monitoring Program (LCMMP) Data, Fire and Resource Assessment Program (FRAP), to identify the conversion rate for their county. This conversion rate, converted to percent, will be used annually as the risk of leakage from an avoided conversion project. For example, for Alameda County, the risk of leakage for an avoided conversion project is 0.01761%.

Table 6.4. Land use conversion trends.*[6]

California Forestland Conversion Rates							
COUNTY	**Avg. Acres Converted/ year**	**Total Forestland Acres**	**Forestland Conversion rate**	**COUNTY**	**Avg. Acres Converted/ year**	**Total Forestland Acres**	**Forestland Conversion rate**
Alameda	621.4	39,739	.0156370	**Orange**	0.4	48,916	.000008
Alpine	0	290,681	0	**Placer**	24.0	556,975	.000043
Amador	0	258,944	0	**Plumas**	115.4	902,303	.000127
Butte	0	380,766	0	**Riverside**	0.4	220,434	.000002
Calaveras	13.2	472,656	.0000279	**Sacramento**	5.0	12,188	.000410
Colusa	0	167,225	0	**San Benito**	238	90,556	.002628
Contra Costa	742.2	41,118	.0180504	**San Bernardino**	5.0	287,799	.000017
Del Norte	524.6	466,176	.0011253	**San Diego**	5.1	381,323	.000013
El Dorado	41.2	883,112	.0000467	**San Francisco**	0	838	0
Fresno	11.2	1,265,636	.0000088	**San Joaquin**	0	1,429	0
Glenn	0	205,265	0	**San Luis Obispo**	4.6	178,596	.000026
Humboldt	104.8	1,536,072	.0000682	**San Mateo**	7	126,023	.000037
Imperial	0	42,552	0	**Santa Barbara**	3.4	232,473	.000015
Inyo	0	253,546	0	**Santa Clara**	302.2	203,684	.001484
Kern	6.6	775,308	.0000085	**Santa Cruz**	21.4	80,473	.000266
Kings	0	7,226	0	**Shasta**	194.2	1,674,363	.000116
Lake	139.2	506,194	.0002749	**Sierra**	0	429,872	0
Lassen	0	607,224	0	**Siskiyou**	25.6	2,288,800	.000011

[6] California Department of Forestry and Fire Protection, and the U.S. Forest Service Monitoring Land Cover Changes in California, North Coast Project Area May 2003. California Department of Forestry and Fire Protection and the U.S. Forest Service Monitoring Land Cover Changes in California, Northeast Project Area January 2002. California Department of Forestry and Fire Protection Monitoring Land Changes in California, South Coast Project Area August 2002. California Department of Forestry and Fire Protection and the U.S. Forest Service Monitoring Land Cover Changes in California, Southern Sierra Project Area September 2005. California Department of Forestry and Fire Protection and the U.S. Forest Service Monitoring Land Cover Changes in California, South Coast Project Area July 2007.
The numbers inserted in this table were taken from the United States Forest Service Change Detection data bases [http://www.fs.fed.us/r5/rsl/projects/change/]. The acres included under average acres of conversion in this table are the average annual acres changed to development per the change detection tables within the final reports. This was a five year project so the total acres changed to development in the final reports were divided by five (5) for each county and then entered as the annual average in this table. The total forestland acres are the total forestland acres for the county. The average annual acres changed to development were divided by the total acres of forestland to get the forestland conversion rate as a table value.

Los Angeles	53	62,637	.000846	**Solano**	102.6	19,218	.005339
Madera	23.2	609,072	.000038	**Sonoma**	77.2	478,936	.000161
Marin	37	89,027	.000415	**Stanislaus**	1.4	3,452	.000406
Mariposa	38.2	554,661	.000068	**Sutter**	0	0	0
Mendocino	165	1,609,637	.000102	**Tehama**	20.2	763,509	.000026
Merced	0	18,748	0	**Trinity**	17.4	1,508,014	.000012
Modoc	0	584,152	0	**Tulare**	0	1,556,703	0

* The LCMMP re-monitor areas over 5 year periods, and the Reserve will work with CDF to update the conversion rates as new data is made available.

Please Note:

- Development refers to residential development, commercial development and land conversion to agricultural crop pasture or grazing lands.
- The LCMMP excludes counties that do not have significant timberlands. The Central Valley, and Southeastern desert counties of Kern, Kings, Fresno, Merced, San Joaquin, Imperial, Riverside, San Bernardino and Inyo counties are partially or entirely excluded.

For avoided conversion projects, onsite activity-shifting leakage can occur when a conversion project occurs within the entity outside of the project's boundaries. Project proponents are required to provide an annual estimate of the entity acres by general forest cover type. This will provide a trend of forest acres over time (Table 6.5).

Table 6.5. Example of tracking cover by general forest cover.

Year	Attribute	Entity Acres
X	Forest	
	Other	
	Entity Acres	

A decrease of forest acres greater than 5% serves as an indication leakage is occurring. Converted acres that exceed this figure must be multiplied by the project's average carbon stocks which serves an onsite activity-shifting leakage estimate unless the project developer can explain and justify (and the verifier verify) the following conditions led to the calculation of the increase:

- *Improved Accuracy in Vegetation Mapping*

  Efforts that improve accuracy in vegetation mapping may result in forest cover estimates greater than 5%. The project proponent will need to demonstrate where these adjustments are occurring and have verified by the verifier

- *Natural Disturbances*

  Fires, disease, and pests are examples of agents that reduce forest carbon stocks and are often beyond the control of humans. While not the result of activity-shifting leakage, the occurrence of such instances may play a role in reducing entity carbon stocks.

- *Planned Conversions*

  Conversions happen as independent events where no direct link to an avoided conversion project can be established. The project proponent will need to demonstrate that no causal links can be established between the project and the conversion activity.

6.4 Quantifying Total Net GHG Reductions

A forest project's total GHG reductions or net CO_2 emissions (i.e. biological emissions) must be calculated and reported on an annual basis. The Reserve defines GHG reductions broadly to include an increase in project carbon stocks relative to baseline levels, as well as other net GHG removals, reductions, and avoided emissions. The total net GHG reductions at sources, sinks, and reservoirs identified within the GHG assessment boundary (Section 5) must be quantified and reported each year, even if net GHG reductions are negative (i.e. there was a net decrease in carbon stocks relative to baseline levels, and/or an overall net increase in GHG emissions due to emissions from any GHG sources).

The steps required for quantification are as follows:

1. Determine actual onsite carbon stocks for the current year, net of any confidence deduction, following the guidance in Appendix A.
2. Subtract actual onsite carbon stocks for the prior year (net of the appropriate confidence deduction), to determine the net change in actual onsite carbon stocks.
3. Subtract from this the difference between current and prior year baseline carbon stocks, as estimated following the requirements in this chapter and the guidance in Appendixes A and B. This will yield the net increment (decrement) in carbon stocks relative to the baseline for the current year.
4. Multiply the result by any leakage adjustment for offsite harvesting, following the requirements in this chapter.
5. Add the difference between actual and baseline carbon in wood products produced in the current year that will remain sequestered for at least 100 years.
6. Subtract any emissions from secondary effects (other than harvest leakage), following the requirements in this chapter.

In accordance with these steps, quantified reductions for each year must be calculated using the following formula:

$$\mathbf{QR_y = [AC_{onsite,\,y} * (1 - CD_y) - AC_{onsite,\,y-1} * (1 - CD_{y-1}) - (BC_{onsite,\,y} - BC_{onsite,\,y-1})] * [1 - L_y] + [AC_{wp,\,y} - BC_{wp,\,y}] - SE_y}$$

Where,

QR_y	quantified GHG reductions for year y
$AC_{onsite,\,y}$	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
CD_y	appropriate confidence deduction for year y, as determined in Appendix A
CD_{y-1}	appropriate confidence deduction for year y-1, as determined in Appendix A
$BC_{onsite,\,y}$	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
L_y	leakage risk percentage for year y *
$AC_{wp,\,y}$	actual carbon in wood products produced in year y that is projected to remain sequestered for at least 100 years
$BC_{wp,\,y}$	baseline carbon in wood products that would have been produced in year y that is projected to remain sequestered for at least 100 years
SE_y	other net secondary emissions caused by the project activity in year y **

* See guidance in this section ** See guidance following this section

Example of Annual Calculation Activities. A similar worksheet is found on the Reserve Software. This example demonstrates the annual reporting requirements that result in the calculation of emissions/reductions associated with the project activity.

Steps shaded below are automatically calculated by the Reserve's online software.								Steps not shaded demand input from the project developer
Annual On-Site (Estimated) Carbon Stocks Accounting Example								
Project Activity Stocks								
Steps		**Year**						Notes
		0	1	2	3	4	5	
1	Live Standing Carbon (Live Trees)	90.0	95.0	100.0	105.0	110.0	115.0	This is the estimated sum of the carbon for the identified pool in the current year, determined through a sampling process and in conformance with the quantification section of this protocol. Enter 'na' if the pool will not be quantified in the project, following guidance on required pools in the quantification section in this protocol.
2	Dead Standing Carbon (Dead Trees and Stumps)	5.0	5.0	5.0	5.0	5.0	5.0	
3	Lying Dead Carbon (Dead Down Wood)	5.0	5.0	5.0	5.0	5.0	5.0	
4	Shrubs/Herbaceous Understory	na	na	na	na	na	na	
5	Litter and Duff	na	na	na	na	na	na	
6	Soil	na	na	na	na	na	na	
7	Project Activity Tons	100	105	110	115	120	125	This is the net carbon for all reporting pools on site in the project area. The project should always report the project activity tons as the best annual estimate of the project, despite any concerns about confidence.
8	Confidence Deduction	10%	10%	10%	5%	5%	0%	The confidence deduction is based on the sampling error of the combined carbon pools quantified in the project, as described in the quantification section. The confidence deduction is applied annually to the annual monitoring reports. This value is calculated as shown in the quantification section.
9	Project Activity Tons(adjusted for confidence for determination of reductions)	90.0	94.5	99.0	109.3	114.0	125.0	The project activity tons are reduced based on confidence only for the determination of reportable reductions. Reportable reductions can change in the year that the confidence is improved (or worsens). In the year that the confidence adjustment changes, the reportable reductions will change as well, provided there are reductions to report.
Baseline Stocks								
10	Live Standing Carbon (Live Trees)	90.0	80.0	70.0	70.0	70.0	70.0	This is the estimated sum of the carbon in the identified pool in the current year, determined through a sampling process for the first year and subsequently through a modeling effort and in conformance with the quantification section and baseline description of this protocol. Enter 'na' if the pool will not be quantified in the project, following guidance on required pools in the quantification section in this protocol.
11	Dead Standing Carbon (Dead Trees and Stumps)	5.0	5.0	5.0	5.0	5.0	5.0	
12	Lying Dead Carbon (Dead Down Wood)	5.0	5.0	5.0	5.0	5.0	5.0	
13	Shrubs/Herbaceous Understory	na	na	na	na	na	na	
14	Litter and Duff	na	na	na	na	na	na	
15	Soil	na	na	na	na	na	na	
16	Baseline Tons	100.0	90.0	80.0	80.0	80.0	80.0	The baseline tons are not affected by the confidence deduction. The baseline incorporates the initial mean and is modeled thereafter. It is considered correct and remains so unless altered from a significant disturbance or justified through an inventory error (generally early in process).
Calculation of Initial Carbon Reductions								
17	Total Initial Cumulative Reductions Discounted for Confidence	0.0	4.5	19.0	29.3	34.0	45.0	The discount is intended to provide a conservative estimate of the allowable reductions to report and sell. A confidence deduction that results in negative reductions (emissions) is reported as zero. Emissions (negative numbers) should be reported if the gross project carbon tons (unadjusted for confidence) minus the baseline tons results in the negative values.
18	Total Annual Initial Reductions Discounted for Confidence (New Tons by Vintage Year)	0.0	4.5	14.5	10.3	4.8	11.0	New annual reductions (emmissions) are the net value of total reductions in current year minus net reductions from the previous year.

Steps	Applying Deductions to Initial Carbon Reductions for Leakage and Other Effects	Year 0	1	2	3	4	5	Notes
19	Leakage Adjustment %	0.0%	3.0%	3.0%	3.0%	3.0%	3.0%	This value comes from the project type specific worksheet of the leakage assessment in the Leakage Section.
20	Leakage Adjustment Value (Tons of Carbon)	0.0	0.1	0.4	0.3	0.1	0.3	Leakage Adjustment value, multiply Total Reductions by the leakage adjustment percentage.
21	Other Effects	0.0	0.0	0.0	0.0	0.0	0.0	Other effects is the calculation of non-biological emissions (above baseline emissions) associated with certain project activities. See the guidance provided under 'Other Effects'.
22	Total Annualized Initial Carbon Reductions (Adjusted for Leakage and Other Effects)	0.0	4.4	14.1	9.9	4.6	10.7	Annualized reductions are the new reductions (emissions) reduced for leakage
	Conversion of Carbon Tons to Metric Tons CO2							
23	Conversion to Tons of CO_2	0.0	16.0	51.6	36.5	16.9	39.1	Conversion of Tons of Carbon to Tons of CO_2 (Multiply metric tons of carbon by 3.6667 to estimate CO_2)

Annual Off-Site Reductions (Non-Estimated) Accounting Example (Currently not available for registration as a GHG reduction)

Steps		Year 0	1	2	3	4	5	Notes
	Wood products is not subject to the confidence deduction since the initial value is measured, not the result of a sampling process that results in an estimation of values.							
	Offsite Project Activity Stocks							
24	Harvested Wood Products Carbon Tons	0.0	2.0	2.0	0.0	5.0	5.0	This is the net carbon off-site in the form of the harvested wood products pool from the project area. This value comes from entity records and can be verified from tax records.
25	Mill Efficiency %	0%	60%	60%	60%	60%	60%	This value comes from the mill where wood products were delivered or from the regional worksheet of mill efficiency provided in the Appendix.
26	Harvested Wood Products Reduced for Mill Efficiency, in Carbon Tons	0.0	1.2	1.2	0.0	3.0	3.0	Mill efficiency reduction is the loss in converting logs into wood products. The Harvested Wood Products is mulitiplied by the mill effiiciency adjustment percentage.
27	End Use and Landfill %	0%	64%	64%	64%	64%	64%	This value comes from the wood product type specific values for 100 year end use and landfills worksheet found in the Quantification Section of this protocol.
28	Total Annualized Carbon in Harvested Wood Products (Adjusted for Emmisions over 100 Years in use Life and Landfills)	0.0	0.8	0.8	0.0	1.9	1.9	Harvested wood products tons of carbon remaining after 100 years from the date of production, including the percentage remaining in use and in landfills.
29	Conversion to Metric Tons of CO_2	0.0	2.8	2.8	0.0	7.0	7.0	Conversion of Tons of Carbon to Tons of CO_2 (Multiply metric tons of carbon by 3.6667 to estimate CO_2)
	Wood Products Baseline Stocks							
30	Harvested Wood Products Carbon Tons	0.0	8.0	8.0	6.0	6.0	6.0	This is the net carbon off-site in the form of the harvested wood products pool from the baseline activity. It is determined from a modeling process.
31	Mill Efficiency %	0%	60%	60%	60%	60%	60%	This value comes from the mill where wood products would likely be delivered or from the regional worksheet of mill efficiency provided in the Appendix.
32	Harvested Wood Products Reduced for Mill Efficiency, in Carbon Tons	0.0	4.8	4.8	3.6	3.6	3.6	Mill efficiency reduction is the loss in converting logs into wood products. The Harvested Wood Products is mulitiplied by the mill effiiciency adjustment percentage.
33	End Use and Landfill %	0%	64%	64%	64%	64%	64%	This value comes from the wood product type specific values for 100 year end use and landfills worksheet found in the Quantification Section of this protocol.
34	Total Annualized Carbon Tons in Harvested Wood Products (Adjusted for Emmisions over 100 Years in use Life and Landfills)	0.0	3.1	3.1	2.3	2.3	2.3	Harvested wood products tons of carbon remaining after 100 years from the date of production, including the percentage remaining in use and in landfills.
35	Conversion to Metric Tons of CO_2	0.0	11.2	11.2	8.4	8.4	8.4	Conversion of Tons of Carbon to Tons of CO_2 (Multiply metric tons of carbon by 3.6667 to estimate CO_2)
	Calculation of Emmissions/Reductions Associated with Offsite Stocks							
36	Total Annual Initial CO2 Reductions/Emissions (New Tons by Vintage Year)	0.0	-8.4	-8.4	-8.4	-1.4	-1.4	This is the comparision of the project activity offsite stocks with the baseline offsite stocks to calculate the emissions/reductions related to offsite stocks
	Sum of Onsite and Wood Products Stocks							
37	**Total annual CO2 (metric tons) Reductions/Emissions**	**0.0**	**7.6**	**43.2**	**28.0**	**15.5**	**37.7**	This is the sum of the wood products emissions/reductions and the onsite emissions/reductions. This would be the reductions available for sale if wood products were available for registration. Since reversal is already calculated into wood products as a decay, the calculation of CO2 tons for the reserve pool does not change.

7 Ensuring Permanence of Credited Emissions Reductions

The Reserve requires that credited GHG reductions be effectively permanent. For projects that sequester CO_2, this requirement is met by ensuring that credited GHG reductions remain sequestered for at least 100 years. The Reserve strongly encourages forest project developers to take steps to mitigate the risk that credited GHG reductions will be "reversed," i.e. emitted back to the atmosphere. Furthermore, the Reserve requires project developers to demonstrate that they have insured against reversals, based on a project-specific risk evaluation. Insurance can take the form of contributing Climate Reserve Tons to a buffer pool administered by the Reserve, or it can take the form of an approved insurance contract with a third-party insurance provider.

The Reserve has three basic requirements related to ensuring the permanence of crediting GHG reductions: (1) a required monitoring, reporting, and verification regime, detailed in Sections 8 and 9 and in the Forest Project Verification Protocol (FVP); (2) the establishment of a Project Implementation Agreement with the Reserve, as detailed in Section 3.3; and (3) the maintenance of an appropriate buffer pool or insurance contract, as detailed in this Section.

7.1 Definition of a Reversal

Project owners must demonstrate, through annual reporting, that any increase in carbon stocks relative to baseline levels is maintained over time. If the difference between project and baseline carbon stocks decreases from one year to the next, the Reserve will consider this to be a reversal in credited reductions. Project owners must compensate for reversals by transferring to the Reserve a number of CRTs equal to the total number of CO_2-equivalent tons that were reversed. The CRTs used to compensate for a reversal may initially be taken out of the Reserve buffer pool, as described below.

7.2 Insuring Against Reversals

7.2.1 Establishing a Buffer Pool Account

Each project will be required to buffer a certain number of CRTs issued to the project, as determined by the project risk rating (determined following the requirements and guidance in Section 7.3 and Appendix C). The buffered reductions will enter a pool to be used in managing reversals for any Reserve forest project. The Reserve will maintain records of the total project reductions as well as the reductions that are held in the buffer pool for the sole purpose of managing the risk of reversals. The percentage of CRTs to be buffered may vary over time, as risks and risk mitigation measures change.

Computing the Buffer Pool Contribution								
38	Onsite CO2 Tons (from row 23 above)	0.0	16.0	51.6	36.5	16.9	39.1	These are the reductions that are at risk of reversal
39	Risk of Reversal %	0.0%	7.5%	7.5%	7.5%	7.5%	7.5%	This value comes from the final worksheet of the risk assessment in Permanence Section
40	**Contribution ot Buffer Pool**	**0.0**	**1.2**	**3.9**	**2.7**	**1.3**	**2.9**	Project contribution to the Reserve Pool for risk of reversal. These will be registered tons, but are not available for sale. These numbers could be adjusted with wood products data depending on outcome of wood products discussions.

7.2.2 Use of the Buffer to Compensate for Reversals

In the event that a reversal of credited reductions occurs, the project's own buffer pool CRTs will be used first to compensate for the reversal. If the reversal exceeds the buffer pool for the project, the Reserve will draw proportionally from other pooled buffers to fully compensate the loss.

As described in Section 8.1, the expected project life is 100 years, and a project may terminate if a reversal reduces the project activity's live standing forest carbon stocks below the standing live stocks established for the baseline. If the project is not terminated, the project can begin creating reductions immediately. The project does not have to rebuild the project stocks that existed prior to the reversal, other than restoring the buffer pool for any remaining (non-reversed) reductions. This shall be done based on calculating the total project buffer percentage that existed prior to the reversal and applying it to the remaining reductions. Subsequent contributions to the buffer pool will be based on the project's current risk rating.

7.2.3 Other Insurance Options for Reversals

It is the Reserve's expectation that other options to insure against reversals will develop for projects in the future. These options or mechanisms could include direct insurance. These other options could be used to directly reduce the calculated reserves required for a project.

7.3 Risk Assessment for Reversals

A risk assessment must be used to determine the quantity of CRTs issued to a project that must be set aside in a buffer pool, as described in Appendix C. Each year a project is issued CRTs, a risk rating is calculated and a corresponding percentage of CRTs is placed in the buffer pool. For example, a project has a verified increase in its carbon stocks relative to baseline levels equivalent to 10 tons of CO_2. The project's risk assessment yields a 10% risk for reversals. Thus, 9 CRTs are issued to the project owner's account and 1 CRT must be deposited in the Reserve's buffer pool.

8 Project Monitoring

It is necessary to assess project performance and changes in carbon stocks over time and to test any earlier estimations made regarding increases or decreases in carbon stocks due to the project activity. This is accomplished through systematic monitoring of project activities and carbon stocks.

8.1 Crediting Period and Required Duration of Monitoring Activities

The Reserve's forest projects are expected to have a project life duration of 100 years from the project's initiation date. Exceptions to the 100-year project life occur when a significant disturbance occurs,[7] leading to a reversal that reduces the standing live carbon stocks below the baseline of standing live carbon that were initially established for the project. This occurrence allows the project developer to terminate a project.

[7] The natural disturbance shall not be the result of intentional or grossly negligent acts of the forest entity or project developer.

Please note that the 100 year project length and ability to terminate does not eliminate the independent requirement of reductions to be maintained for 100 years,[8] measured from the year in which the reduction is first measured and reported (for more information on length of reductions, see Section 7).

To promote transparency, you must include an ownership summary. The purpose of this summary is to demonstrate who is eligible to report the project and to include transparent details regarding any intended external uses of the project (e.g. sale, trading, crediting, etc.). Please note that in collecting this transparent information, the Reserve is not providing credit or acting as a broker to trade any project GHG reductions.

8.2 Annual Monitoring Requirements

As part of an ongoing assessment and reporting of a project's carbon stocks and project activities, annual monitoring is required. The purpose of the monitoring process is to update the reported project's carbon stocks, identify if a reversal has occurred and update the assessment of leakage. Annual monitoring reports are only required to be accompanied with a field review on a six year cycle, which is explained in the verification protocol. The annual monitoring reports will be reviewed by a verifier prior to registering the stocks with the Reserve.

Updating the inventory of project carbon stocks

The management of the project inventory must include a methodology to update the forest inventory, accounting for harvest, growth, and natural disturbances, on an annual basis. Inventory updates can be conducted with the use of forest growth models that rely on field data that are no older than 12 years. This is intended to minimize errors associated with dependence on growth models. The confidence of the inventory must be calculated and reported on an annual basis.

Annual Monitoring Report

On an annual basis, project developers are required to complete an online Annual Monitoring Form which is part of The Climate Reserve. The purpose of this report is to report your estimated annual carbon stocks and confirm that no reversals are occurring.

Specifically, your annual monitoring report must include the following:

- *Carbon stock estimate*

  Provide an estimate of the project's carbon stocks, based on your inventory methodology that may include a combination of sample plots, harvest deductions and modeled growth. The project's carbon stocks will be reported independently by the carbon pools reported.

- *Inventory Confidence*

  The inventory confidence needs to be reported on an annual basis to ensure the quality of the inventory meets the Reserve's standards. Deductions to reductions based on the level of confidence in the inventory are assessed annually.

[8] In the event of a reversal of reductions, the tons that are stored for the greatest duration are considered as the first tons reversed.

- Harvested Wood Products need to be reported on an annual basis and calculated by the methodology outlined in Appendix A.

- Risk Assessment Reserve Calculation needs to be evaluated on a annual basis using the appropriate guidance from the section on risk assessment. The Reserve tons need to be calculated and reported.

- *Disturbances*

  The written report should list any disturbances (significant disturbances etc.) that have occurred, the date of the disturbance(s), the extent of the disturbance, including whether it is a significant disturbance, and whether it led to a reversal of obligated reductions. The change in inventory associated with the disturbance is normally managed with update procedures, which may include field sampling activities. A good faith estimate of the inventory reduction should be submitted if insufficient time exists to update the inventory following a disturbance. The inventory should be rectified with acceptable inventory procedures in the subsequent year if a good faith estimate is provided.

- *Leakage*

  Leakage must be assessed and reported annually using the appropriate guidance for the specific project type described in the section on leakage. The leakage worksheet for each project type must be submitted to the Reserve on an annual basis. This includes the confidential reporting of harvest volumes and timber inventory for Improved Forest Management projects.

8.3 Rationale for Verification

California Registry's verification process requires you to hire an approved 3rd party verifier (listed on California Registry's website: www.climateregistry.org) to review and assess your reported required data to confirm that you have adhered to California Registry's reporting protocols and have compiled your GHG inventories accurately each year. This process is an integral component of California Registry's program. It helps to ensure the consistency and credibility of the GHG data reported across organizations, which, in turn enables the State of California to consider your verified GHG data if it is affected by regulation in the future. In addition, the verification process provides confidence to the public that the GHG information you report is accurate. A detailed description of verification activities and scheduling is found in the companion Forest Verification Protocol (newest version not produced yet).

9 Reporting Requirements

Placeholder (list of everything reported to Registry)

9.1 Forest Carbon Inventory

The Reserve requires a complete inventory for the estimates of carbon stocks to be verified. A complete inventory must be executed by the time you report your annual carbon stock estimate to the Reserve. This complete inventory must be maintained throughout the time the project is reported to the Reserve. A complete inventory includes an estimate of carbon stocks from the required pools within the project that meets or exceeds the minimum confidence standards described in Appendix A.

The inventory and the required verification will be used as the basis for determining whether a reversal has occurred (Section 7). All credited reductions for a project are assumed to be reversed if a project developer, or subsequent landowner, chooses not to undergo verification.

Expertise of a Professional Forester:

All reports that reference biological emissions must be submitted with the oversight of a professional forester. See the definition section for professional forester. If the project is located in a jurisdiction without a professional forester law or regulation then the Certified Forester credentials is required so that professional standards and project quality are maintained. California Registry may evaluate and approve alternative certification credentials if requested, but this would only apply to jurisdictions where professional forester laws or regulations do not exist. This requirement does not preclude the use of technicians or other unlicensed/uncertified persons working under the supervision of the professional forester.

9.2 Attestation of Title

The ownership summary should include the following information:

- Owner(s), or representative of association, of project's commercial/non-commercial trees

9.3 Transparency

The Reserve requires complete GHG data transparency for all forest projects, since the carbon stock, GHG emissions, and verified emission reduction data will likely be of interest to and potentially used by a variety of stakeholders after it is reported to the Reserve. To uphold this principle, forest entities must disclose all forest activities that may impact their C stocks (voluntary agreements/commitments, etc.) beyond the specific GHG data required by the Reserve. Such transparency will help to ensure the environmental integrity of the data and assist stakeholders to better understand and interpret the GHG data resulting from the Reserve.

10 Glossary of Terms

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 fuels reductions, and other management activities designed to achieve forest sustainability health objectives.
Additionality	Forest project practices that exceed the baseline characterization, including any applicable mandatory land use laws and regulations.
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.
Applicable Mean	The averaged carbon in the standing live carbon pool (live tree pool) from private lands within a project's assessment area, as calculated using the USFS FIA sample plots.
Assessment Area	A geographic area defined by the Reserve that consists of a distinct forest community within common regulatory and political boundaries that affect forest management.
Baseline Activity	The volume/biomass of harvest, inventory, and growth of forests and forest products associated with the baseline modeling scenario.
Avoided Conversion	Specific actions that prevent the conversion of native forest to a non-forest use, i.e. residential or commercial development or agriculture. This activity is also a type of project that may be registered in the Reserve.
Best Management Practices	A practice or usually a combination of practices that are 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.[9]
Biological emissions	For the purposes of the forest protocol, biological emissions are GHG emissions that are released

[9] Obtain reference from the Dictionary of Forestry

	directly from forest biomass, both live and dead, including forest soils. In the first three years of reporting the only biological emission type that is required to be reported for forest entities and projects is CO_2, as identified in the Quantification Section of the protocol. Biological emissions are deemed to occur when the reported tonnage of carbon stocks decline at the project level.
Biomass	The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass.[10]
Bole	A trunk or main stem of a tree.
Carbon pool	A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include aboveground or below-ground biomass or harvested wood products, among others.
Carbon stocks	The carbon contained in identified forest biomass categories (i.e. carbon pools), such as above and below ground biomass, at a specific point in time.
Culmination of Mean Annual Increment	The culmination of the mean annual increment (biomass increase) is point where the maximum mean annual increment is reached.
De minimis	The emissions associated with a carbon pool at any point during the project life is so minor as to merit disregard; defined as less than or equal to 5% on a cumulative basis for total carbon stocks.
Direct emissions	Greenhouse gas emissions from sources that are owned or controlled by the reporting entity.
Entity non-biological baseline	Datum against which a forest entity can measure its non-biological GHG emissions.
Equity Share	Fractional percentage or share of an ownership interest.
Forest	Lands that support, or can support, at least 10 percent tree canopy cover and that allow for management of one or more forest resources, including timber, fish and wildlife, biodiversity, water quality, recreation, aesthetics and other public benefits.
Forest entity	A corporation or other legally constituted body,

[10] Climate Change 2001, mitigation; Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change

	city or county, each state or federal government agency or individual that owns forest land.
Forest management	The commercial or noncommercial growing and harvesting of forests.
Forest project	A planned set of activities to remove, reduce or prevent carbon dioxide emissions in the atmosphere by conserving and/or increasing forest carbon stocks.
Forest project baseline	A long-term forecast of the forest practices (or absence thereof) that would have occurred within a project's boundaries in the absence of the project activity.
Forest project greenhouse gas reduction	Removals or reductions of CO_2 and prevented CO_2 emissions resulting from Reserve-approved forest projects. GHG reductions are calculated as gains in carbon stocks over time relative to the project baseline.
GHG reductions	See forest project greenhouse gas reduction.
Greenhouse Gases (GHG)	For the purposes of the Reserve, GHGs are the six gases identified in the Kyoto Protocol: Carbon Dioxide (CO_2), Nitrous Oxide(N_20), Methane(CH_4), Hydroflourocarbons (HFCs), Perflourocarbons (PFCs), and Sulphur Hexafluoride(SF_6).
Improved forest management	Changes in forest management to increase or maintain overall forest carbon stocks. This activity is also a type of forest project that may be registered in the Reserve.
Listed	A project is considered "listed" when the project developer has created an account with the Reserve, submitted the required Project Submission Form and related required documents, paid the project submission fee, and the Reserve has approved and accepted the project for listing.
Lying dead biomass	Any piece(s) of dead woody material, e.g. dead boles, limbs, and large root masses, on the ground in forest stands. The Reserve requires the carbon in lying dead biomass with a minimum diameter of 6 inches to be measured.
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.[11]

[11] Jepson Flora Project, see http://ucjeps.berkeley.edu/jepsonflora/.

Natural forest management	Forest management practices that promote and maintain native forests comprised of multiple ages and mixed native species at multiple scales from the harvest unit (less than 40 acres) up to the watershed spatial scale (third or fourth order watershed level) approximately 10,000 acres in size. The application of this definition, its principles, detailed definition, and implementation, are discussed further in the section 3 (eligibility criteria)
Non-biological emissions	Greenhouse gas emissions that are not directly released from biomass. For example, GHGs from fossil fuel combustion qualify as non-biological emissions.
Optional reporting	Greenhouse gas reporting results that are reported to, but not verified by, the Reserve.
Permanence	Refers to the duration of the greenhouse gas reductions that are achieved and maintained as a consequence of the forest project. Pursuant to this protocol, forest-based reductions shall be permanent and are considered permanent when maintained for 100 years
Professional Forester	A professional engaged in the science and profession of forestry. A professional forester is credentialed in jurisdictions that have professional forester licensing laws and regulations. Where a jurisdiction does not have a professional forester law or regulation then a professional forester is defined as having the Certified Forester credentials managed by the Society of American Foresters (see www.certifiedforester.org).
Project developer	An entity that undertakes a project activity, as identified in the Forest Project Protocol. A project developer may be an independent third party or the forest entity.
Project Life	Refers to the duration that a project activity and its associated monitoring and verification are maintained.
Reforestation	The establishment and subsequent maintenance of native tree cover on lands that were previously forested but have had less than 10% tree canopy cover for a minimum time of ten years or have been subject to a significant disturbance within the last ten years that is not the result of intentional or grossly negligent acts of the landowner or reporting entity. This activity is also a type of project for public or private forest lands that can be registered in the Reserve.

Registered	A project is considered "registered" when the project has been verified by an accredited third-party verifier, submitted by the project developer to the Reserve for final approval and approved by the Reserve.
Reversal	The loss of verified reductions
Sequestration	The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of CO_2 from the atmosphere through land-use changes[12] and changes in forest management.
Significant disturbance	Any natural impact on a project's selected carbon pools that results in a loss of at least 20% of the total carbon stocks of the selected pools and is not the result of intentional or grossly negligent acts of the forest entity or project developer.
Standing dead biomass	Standing dead tree or section thereof, regardless of species, with minimum diameter of three inches.
Submitted	A project is considered "submitted" when all of the appropriate forms have been uploaded and submitted to Reserve software, and the project developer has paid the project listing fee.
Tree	A woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of 3 inches and a minimum height of 15 feet with no branches within 3 feet from the ground at maturity.[13]
Verification	The process used to ensure that a given participant's greenhouse gas emissions or emissions reductions has met the minimum quality standard and complied with the Reserve's procedures and protocols for calculating and reporting GHG emissions and emission reductions.

[12] Climate Change 2001, mitigation; Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change
[13] Insert Society of American Foresters citation

11 References

Use APA style for references.

Appendix A Developing a Forest Project Carbon Inventory

This appendix provides guidance to quantify your project's initial forest carbon inventory. It explains how to identify the required and optional forest carbon pools to measure for a forest project, as well as the steps necessary for calculating the existing carbon stocks in the selected pools within your project area. This information will serve as the basis for estimating carbon stocks in a project's baseline over time, as well as the anticipated changes in carbon stocks due to the project activity. The assessment of GHG reductions and emissions from forest projects are based on changes in forest carbon stocks over time. The forest project inventory provides the accounting foundation for assessing these changes.

This appendix explains the essential components to complete your forest project carbon inventory. It then provides guidance regarding the quantification of all your required and optional direct carbon pools. Please refer to the Worksheet for Summarizing Carbon Pools and Calculating Total Carbon Weight, Table A.8,which should be used as you quantify each of these pools. In Appendix B, additional guidance is provided on the use of models to project baseline carbon stocks over time.

A.1 Provide Background Information on Forest Area

To begin the inventory process, you must supply a general description of the activities and land use patterns that influence your project forest carbon stocks and biological emissions. This information should help inform the initial design of your forest inventory if needed, as well as your estimations of forest carbon stock and emissions. This information will be reviewed in the verification process.

When you are ready to quantify your forest carbon stocks, you should refer to the Project Summary Worksheet on the Reserve website to provide the following information:

- Forest entity and project boundaries
- Acreage of entity forest area
- Latitude/longitude or Public Land Survey
- Existing land cover and land use
- Topography
- Forest vegetation Types
- Site classes
- Watercourses in area (4^{th} order or greater)
- Land pressures and climate regime

This information must also be presented in a map during verification or a justification for exclusion provided.

A.2 Measure Carbon Pools in the Project Area

The required measurements to determine carbon stocks are broadly grouped into the following categories:

1. Above-ground living biomass
2. Below-ground living biomass
3. Dead biomass
4. Soil
5. Wood products

Values for some of these categories of carbon will be determined through direct sampling. Table A.1 summarizes the categories with their associated pools and identifies which pools must be quantified for all projects versus those that may be excluded depending on the project. It also shows how the value for the pool is determined.

Measurement of live aboveground tree carbon is always required. By default, measurement of carbon in other pools is also required. Pools may only be excluded if doing so will have no deleterious effect on total quantified GHG reductions. The cumulative net GHG emissions from all excluded pools over the project lifetime must be less than 5% of total quantified GHG reductions/removals for the project.

The intent of these reporting criteria is to ensure that proper accounting is conducted where significant emission might occur. The justification for excluding a pool is subject to review at each verification.

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

Category	Carbon Pool	Required?	Determination of Value
Living biomass	Above-ground living Biomass	Yes	Sampled in Project
	Below-ground living biomass	Yes, unless justified	Calculation based on above ground sampling
	Shrubs and Herbaceous Understory	Yes, unless justified	Sampled in Project
On-site Dead biomass	Standing Dead Biomass	Yes, unless justified	Sampled in Project
	Lying Dead Wood	Yes, unless justified	Sampled in Project
	Litter	Yes, unless justified	Sampled in Project
Soil	Soil	Yes, unless justified	Sampled in project
Off-site dead biomass	Wood Products	Yes, unless justified	Decay calculation from volume of harvested wood

A.3 Onsite Forest 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 trunk, or bole diameter, form, and height of the tree. The equations provided in this appendix facilitate biomass and carbon mass estimations using the bole diameter and total height for live trees and sound standing dead trees. Estimates of lying dead and standing dead tree (for non-sound trees) biomass can be computed in terms of cubic volume and subsequently converted to biomass/carbon mass estimates. Verifiers may grant approval to use different allometric equations than those provided by the Reserve.

A complete inventory must include a sampling methodology, a set of inventory plots, and analytical methods to translate field measurements into volume and/or biomass estimates. The plot data used for deriving the estimates must have been sampled within the last 12 years. The scheduling of plot sampling may occur in one time period or 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.

An exception to the 12 year plot life is accepted where the project developer can demonstrate to the verifier that the process utilized for updating the inventory, addressing both forest growth and harvest, adequately estimates the current inventory. To accomplish this, a statistically valid subsample must be conducted and determined to be within the confidence interval of the updated (computer grown and updated for harvest) inventory using +/- 10% @ 90% confidence interval for both recent subsamples and computer grown and updated for harvest methods.

The steps that follow provide more detailed guidance to establish and maintain a complete inventory and estimate carbon stocks. Please use the worksheet in Step 10 to organize your results.

Step 1 – Develop Inventory Methodology and Sample Plots

Required

As your initial inventory step, you must develop and describe a methodology to sample for biomass or volume in the required carbon pools. Appendix D contains recommended references for developing sampling methodologies. Sampling methodologies for all included carbon pools, where a determination of the biomass or volume is derived from sampling, is also required. If you are using an existing inventory either partially or for all your data then follow the same sequence of steps to ensure the existing inventory meets the requirements.

Your sampling methodology and measurement standards should be consistent throughout the time you report to the Reserve. Improvements in forest inventory accuracy or efficiency from new methodologies may occur over time that may prompt you to make changes to your inventory. The overall quality of the inventory should be maintained or improved by such changes and estimates of carbon stock changes shall not be reduced in accuracy relative to the original sampling design. All sampling methodologies and measurement standards must be statistically sound and reviewed by verifiers. While stratification is not a requirement, it should be noted that it does have the potential to simplify verification and possibly lower the costs of verification for reporters. Temporary flagging of plot center, as is customary to allow for check cruising, is required to ensure ongoing inventory quality and potential opportunities for verifiers to visit plots when verifying inventory procedures. If permanent plots are used, which are statistically efficient for stock change estimates, then permanent plot monumenting must be sufficient for relocation. Plot centers should be referenced on maps, preferably from GPS coordinates. The methodologies utilized shall be documented and made available for verification and public review. The design of your sampling methodology and measurement standards must include the requirements stated in the following table.

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

Carbon Pool	Name of Requirement	Description of Requirement
Above-ground Living Biomass	Diameter (breast height) Measurements	Stated minimum diameter in methodology not to be greater than 5 inches.
	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 will 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 the Reserve.
Below-ground Living Biomass	Plot-level Allometric Equation used for Estimating Biomass	Apply model (Cairns et al. 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 by the Reserve.
Herbaceous Understory	Sampling Methodology	The Reserve recommends the sampling methodology prepared by Brown et al. (2004). This methodology is referenced in Appendix D. Alternative methodologies will need to be reviewed and approved by the Reserve.
Standing Dead Biomass	Diameter (breast height) and top Diameter Measurements	Stated minimum breast height diameter in methodology not to be greater than 5 inches. 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.
Litter and Duff	Sampling Methodology	The Reserve recommends the litter and duff methodology prepared by Brown et al. (2004). This methodology is referenced in Appendix D. Alternative methodologies will need to be reviewed and approved by the Reserve.
Lying Dead Biomass	Diameter	Stated minimum average diameter in methodology not to be greater than 6 inches for pieces of dead wood at least 10 feet in length. If the average diameter is greater than 16 inches, the minimum length for reporting not to be greater than 6 feet. Anything not meeting the measurement criteria for lying dead wood will be considered litter.
	Measurement Tools	Description of tools used for length, diameter and plot measurement.
	Measurement Standards	The methodology shall include a set of standards for height and length measurements.
	Plot Layout	A description of plot layout (may be the same as the layout for live tree biomass).
	Merchantability of Trees	The methodology shall include all trees regardless of current merchantability to be including in the sampling design.
	Density by Decay Class	Description of methodology used to derive density estimates for each species (group) by wood density class.

Step 2 – Estimate Carbon in Trees from Sample Plots

Required

Aboveground live tree biomass estimates are required for all projects. You are responsible for determining appropriate methodologies for sampling to determine tree biomass. These estimates should be computed on a per hectare basis. The estimate of aboveground live tree biomass will be combined with the estimates of biomass from other carbon pools for a mean estimate of the required pools derived from sampling, along with a statistical summary that describes the statistical confidence of the estimate.

The following equations are provided for a few common California species for estimating tree biomass (kilograms per tree) from diameter (DBH) and total height (HT) measurements.* This list does not contain all species that you may encounter in your projects, the references contain a comprehensive list of biomass functions. The Reserve will accept the application of equations that are more accurate than those referenced here. Diameter measurements are in inches and height measurements are in feet (note: the use of these functions is required for improved forest management projects for which you need to compare your current inventory to the FIA mean, which is based on these functions). The bole total volume (VOL) is calculated first and then multiplied by the specific gravity 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 references, which are Means et al. (1994) and Waddel and 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 * 28.70) / 2.204622	Exp(-4.3103+2.43*ln(DBH*2.54))	Exp(-3.6941+2.1382*ln(DBH*2.54))
Ponderosa pine	(VOL * 23.71) / 2.204622	Exp(-3.6263+1.34077*ln(DBH*2.54)+ 0.8567*ln(HT*0.3048))	Exp(-4.1068+1.5177*ln(DBH*2.54)+ 1.0424*ln(HT*0.3048))
Coast redwood	(VOL * 21.22) / 2.204622	Exp(7.189689+1.58375*ln(DBH*2.54))/1000	0.199+0.00381*(DBH*2.54)^2*(HT*0.3048)
Tanoak*	(VOL * 36.19) / 2.204622		
*Tanoak biomass is in one equation because the bole, bark and crown volume is in one equation.			

The derived estimate of biomass shall be multiplied by 0.5 to calculate the mass (kg) in carbon. This product shall be multiplied by 0.001 to convert the mass to metric carbon tons.

Because of the difficulties associated with measuring the below ground carbon component of trees, the Reserve allows for the estimation of this component of tree carbon through the use of a regression equation (Cairns et al., 1997). This equation provides a practical and cost-effective approach that estimates below ground biomass based on the sampling-based calculation of above ground biomass only:

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

Where,

BBD = belowground biomass density in tons per hectare

ABD = aboveground biomass density in tons per hectare

It is important to note that this equation must be applied at the plot level, after estimates of aboveground biomass have been calculated as described above.

Example A.3. 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 in the Forest Project Protocol. 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 estimate total biomass in trees on plot 1. Plot 1's estimate of aboveground 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 belowground biomass is 36,211 kilograms per hectare. The combined estimate of biomass in Plot 1 is 383,086 kilograms per hectare.

Step 3 – Estimate Carbon Standing Dead Biomass from Sample Plots

Required Unless Justified to Exclude

The carbon stocks in standing dead biomass, including stumps, must be included in the project inventory report unless adequately justified to leave out. If included, it must be considered in the monitoring process and any projections of project stocks. References for developing sampling methodologies are included in Appendix D.

The sampling methodology and protocols for deriving biomass estimates will be developed as part of an overall sampling strategy (discussed in Step 1). The estimate of standing dead biomass 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 carbon tons by multiplying the result by 0.001

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 both lying dead wood and 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 carbon tons on a per hectare basis. A description of a methodology to generate the density factors can be found in the Brown et al. (2004) document mentioned above.

Step 4– Estimate Carbon in Lying Dead Wood

Required Unless Justified to Exclude

The carbon content of lying dead wood, that is wood biomass that is not standing, must also be estimated in all entity inventories unless it can be justified to exclude. As with standing dead wood, this category may not be present initially. It should be considered in the monitoring process and any projections of entity carbon stocks. References for developing sampling methodologies, which are referenced in Appendix D, include Brown (1974), Harmon and Sexton (1996), and Brown et al. (2004).

Field measurements of lying dead wood enable the calculation of volume to be easily computed. The computed volume will need to be converted to biomass density by applying conversion factors that may be based on default density values by decay class found in Harmon et al. (2008) or a sub-sample of material that represents the species groups and decomposition classes. If direct sampling is used then the methodology developed for lying dead wood 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 carbon tons on a per hectare basis. The carbon tons estimate is inserted into the worksheet in this Appendix. A description of a methodology to generate the density factors, if direct sampling is used, can be found in the Brown et al. (2004) document mentioned above.

The estimate of carbon tons for the lying dead pool and the standing dead pool may be summed with the live tree pool for each sampled plot. This will provide the basis for determining the overall carbon ton estimate and descriptive statistics for the pools, including wood products if applicable. The overall carbon ton (per hectare) estimate of the required pools and the descriptive statistics are input into the worksheet in Step 10.

Example A.5. Quantification Example (Part V – Lying Dead Wood)

Lying dead wood is sampled on every plot. The chart below displays summary data for lying dead biomass for the first plot in Stratum 1.

Strata 1										
Lying Dead Wood										
1	2	3	4	5	6	7	8	9	10	11
Plot	Log Number	Species	Large end Diameter	Small end Diameter	Total Length on plot (mt)	Density	Volume (cubic meters)	Biomass (kg)	Weight (per Hectare)	Total Biomass per Hectare
1	1	Tanoak	30	15	3.6	Rotten	0.6	24.0	25	600
1	2	Redwood	109	96	2.3	Sound	1.9	684.0	25	17,100
							Sum			17,700

The sampling method used in this example is a fixed area plot. The area sampled is a 1/25th hectare plot. The entries in the columns are similar to those already discussed for trees and standing dead trees. The volume in lying dead wood is calculated first and subsequently converted to biomass using the coefficients developed from the density sub-samples.

The sum of the per hectare biomass estimates from the tree, standing dead, and lying dead biomass are summed to determine the combined biomass estimate on Plot 1. The result of summing this example is shown below.

Plot 1		
Carbon Pool	**Biomass Sum per Hectare (kg)**	**Carbon Metric Tons per Hectare**
Trees	346,874	173
Standing Dead	57,054	29
Lying Dead	17,700	9
Total Biomass	421,628	211

The biomass sums are multiplied by .5 to convert to carbon biomass and subsequently by 0.001 to convert to metric carbon tons, as described in Step 2 in the forest project protocols. This process is completed for all plots in Stratum 1 and Stratum 2. The sample results from Plot 1 indicate that there is 211 carbon tons per hectare.

Step 5 – Estimate Carbon in Shrubs and Herbaceous Understory from Sample Plots

Required Unless Justified to Exclude

Any methodology developed for measuring carbon in shrubs will need to be reviewed by verifiers. Appendix D provides a reference that can be used to predict aboveground biomass of plant species in early successional forests of the western Cascade Ranges. The estimate will be computed in terms of metric carbon tons and input into Table A.8.

The use of the most applicable biomass estimation methods may be used including photo series, the use of estimation functions from published papers, direct sampling, or combinations of approaches.

Step 6 – Estimate of Carbon in Litter and Duff

Required Unless Justified to Exclude

Litter is the dead plant material that can still be identified as leaves, grasses and small branches. The largest material that can be considered litter is the minimum diameter stated in the methodology for lying dead wood. The duff layer is the organic material layer at the soil surface under the litter layer. The duff layer consists of dead plant materials that cannot be identified as leaves, grasses, and small branches. The estimate will be computed in terms of metric carbon tons. The mean estimate is input into the Litter and Duff Section in the worksheet in Step 10 on a per hectare basis.

The use of the most applicable biomass estimation methods may be used including photo series, the use of estimation functions from published papers, direct sampling, or combinations of approaches.

Step 7 – Estimate of Carbon Tons in Soil

Required Unless Justified to Exclude

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). The Reserve recommends the soil sampling methodology prepared by Brown et al. (2004) that can be found in Appendix D.

The estimate will be computed in terms of metric carbon tons. The mean metric carbon ton estimate for this pool will be input into the Soil Section in Table A.8 on a per hectare basis.

A.4 Account for Confidence of Estimates

Required

The Reserve prefers all estimates of reported carbon pools, required or not, to have a high level of statistical confidence. Standards have been developed by the Reserve for these pools. The standards are designed to reward project developers with stocks for carbon tons provided that they meet rigorous statistical protocols and confidence levels established by the Reserve. Discounted stocks for reported carbon tons will be assigned to project developers whose statistical confidence levels are less than the desired standards. Discounts are applied to the required confidence deduction. Minimum standards have also been set, which establish the baseline statistical confidence for a project to be considered.

All carbon estimates derived from sampling can be measured statistically in terms of the size of the Standard Error relative to the Estimate of the Mean. This establishes the Confidence Limits and can be expressed as a percentage of the Mean. Project level estimates will be evaluated at 90% Confidence Limits (1 Standard Error* 1.645 (t value for infinite degrees of freedom). Larger Confidence Intervals indicate that there is less confidence in the Mean Estimate than smaller Confidence Intervals. Table A.4 displays the level of deductions assigned based on Confidence Intervals. The adjusted biomass estimate is determined by subtracting the deduction from the mean estimate.

Confidence levels will be determined for the combined estimate of the included pools derived from sampling (does not include wood products pool). The mean estimate of all reported pools and the confidence deduction is input into the worksheet in Step 10.

Table A.4. Biomass deductions based on level of confidence in the estimate derived from field sampling.

Sampling Error no Greater than X% (Percentages Below) on Either Side of the Mean Estimate at the 90% Confidence Level (1 standard error x 1.645)	Contributions to Confidence Deduction from Included Pools
0 to 5%	0%
5.1 to 20%	Amount over 5.1% to the nearest 1/10th percentage
20% or greater	Unacceptable

A.5 Estimate Carbon in Wood Products

Comment [d1]: NOTE: The requirements and guidance in this section is preliminary. The CCAR forestry protocol working group is continuing to deliberate on issues related to the quantification and ownership of carbon stored in wood products and will submit final recommendations for public review in January 2009.

The carbon in wood products may be estimated as that carbon that persists after decay over a 100-year period. The processes described here follow the EPA 1605(b) methodology (Technical Guidelines for Voluntary Reporting of Greenhouse Gas Program, Ch. 1, Emission Inventories, Section 1) for accounting for the long-term storage of wood products. The process is provided here for convenience. Please see Smith et al. (2006) for a more detailed description as the 1605(b) procedure was adapted from this paper. The product-based estimates general procedures are found in section 1.3.2 of the 1605(b) document.

The accounting of wood products should include only those trees harvested within the project boundaries. Trees harvested outside of your forest entity's physical boundaries shall not be counted as part of your wood product pool. A harvest that leads to the production of wood products within your entity must occur for the wood products pool to have value. The carbon from harvested trees is transferred to the wood products pool in the year that it was harvested and must be accounted for in this manner. The timing of this is important to keep in mind for reporting clarity and proper accounting. The amount added to the wood carbon pool is the 100-year discounted value for wood that is estimated to still be in-use and in the landfill. Each year a harvest occurs, the discounted amount harvested is added at the appropriate decay rate as shown in the wood products worksheet below.

Process 1. Determine amount of carbon harvested and transferred to Wood Products Pool

This process applies to projects that have removed forest stocks for conversion to wood products in the reporting year. If you have no removals reported in the reporting year, you will go to process 3 to record the pool from previous years. Your annual estimate for your wood products pool must be based on the current or most recent harvest volume reported to the California Board of Equalization (BOE) or third party scaling reports. The BOE reports will include a summary of harvested volume (board feet or cubic feet) by species delivered to the point of sale. If you have volume measures then the conversion from volume to carbon weight is done in Table A.6. Enter the volume or weight for each category in the first row and then multiply by the factor to convert to tons of carbon. Sum the carbon across categories; this value goes to process 2 below.

If you have weight of wood products then multiply by the appropriate pounds per square foot values for each forest type species group shown in Table A.5 below. Sum the weights for each species to get a total weight for all harvested wood. Multiply this total value by 0.5 pounds of carbon/ pound of wood to compute the total carbon weight, and then convert to tons of carbon (1 metric ton = 2,240 pounds). This value goes to process 2 below.

Table A.5. Specific gravity of green softwoods and hardwoods by forest type for the Pacific Southwest (from EPA 1605(b) Table 1.4).

Forest Type	Specific Gravity of Softwoods	Specific Gravity of Hardwoods
Mixed Conifer	0.394	0.521
Douglas-fir	0.429	0.483
Fir-spruce-m.hemlock	0.372	0.510
Ponderosa pine	0.380	0.510
Redwood	0.376	0.449

Table A.6. Wood Products Conversion Worksheet

<table>
<tr><td colspan="11">Allocate the end use of the total wood products by assigning the volume or weight for each class (A – K). Multiply each column value from by percentages assigned below in order to separate wood products carbon into product classes. Insert values into boxes (2A-K) below each corresponding product class. Values in (2A-K) are carbon (metric tons) in each product class for the current year and are added to total project carbon stores using a calculation below.</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td></tr>
<tr><td>Softwood lumber / laminated veneer / glulam lumber / I-joists</td><td>Hardwood lumber</td><td>Softwood lumber</td><td>Oriented strandboard</td><td>Non structural panels (average)</td><td>Hardwood veneer / plywood</td><td>Particleboard / medium density fiberboard</td><td>Hardboard</td><td>Insulation board</td><td>Other industrial products</td><td>Paper</td></tr>
<tr><td>__MBF</td><td>___MBF</td><td>____MSF</td><td>_MSF</td><td>____MSF</td><td>____MSF</td><td>____MSF</td><td>__MSF</td><td>____MSF</td><td>___MCF</td><td>__tons</td></tr>
<tr><td>MBF</td><td>MBF</td><td>MSF, 3/8”</td><td>MSF, 3/8”</td><td>MSF, 3/8”</td><td>MSF, 3/8”</td><td>MSF, 3/4”</td><td>MSF, 1/8”</td><td>MSF, 1/2”</td><td>MCF</td><td>Tons, air dry</td></tr>
<tr><td>0.443</td><td>0.765</td><td>0.236</td><td>0.275</td><td>0.289</td><td>0.286</td><td>0.587</td><td>0.138</td><td>0.220</td><td>7.484</td><td>0.496</td></tr>
<tr><td>(2A)</td><td>(2B)</td><td>(2C)</td><td>(2D)</td><td>(2E)</td><td>(2F)</td><td>(2G)</td><td>(2H)</td><td>(2I)</td><td>(2J)</td><td>(2K)</td></tr>
</table>

Process 2. Accounting for mill inefficiencies

The conversion of logs to wood products has been estimated to be approximately 67.5% efficient for the Pacific Southwest (see EPA 1605(b) Table 1.6, year 0, in use). That is, approximately 67.5% of the delivered log volume is converted into wood product volume. The remainder is considered to be immediately emitted; the energy component is ignored as that accounting belongs to the energy sector. The calculation for mill efficiency is accomplished by multiplying the carbon tons from Process 1 by 0.675.

Process 3. Wood product decay

In order to account for the decomposition of harvested wood over time, a decay rate is applied to wood products based on the half-life of carbon as determined by the wood product class. The applicant can check with the mill where the logs are sold to determine the product categories they sell and place in the appropriate row and column of the worksheet below. The annual reporting for a removal shall be a constant value over time since the 100-year value is used (EPA 1605(b) Tables 1.8 (in use) and 1.9 (landfill). Specific values were used where available; otherwise the miscellaneous products value was used.

This worksheet includes two different calculations regarding wood products and wood product decay. The first calculation allocates your carbon weight by wood product class. The second calculation determines the amount of carbon remaining from the previous year's wood product carbon classes and adds this value to the current year's product class values. The use of this procedure is required for accounting for the wood products pool. The factors in the next to the last row are to convert from the units given (MBF is thousand board feet, MSF is thousand square feet, MCF is thousand cubic feet).

Table A.7. Wood Products Decay Worksheet

<table>
<tr><td colspan="9">Metric Carbon Tons in Current Year's Wood Products from Process 2 above.</td><td colspan="2">(1)</td></tr>
<tr><td colspan="11">Allocate the end use of the total wood products by assigning a percentage for each class (A – K). Multiply value from (1) by percentages assigned below in order to separate wood products carbon into product classes. Insert values into boxes (3A-K) below each corresponding product class. Values in (3A-K) are carbon (metric tons) in each product class for the current year. Multiply the values in 3A-K by the 100-year decay factor and put in 4A-K.</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td></tr>
<tr><td>laminated veneer / glulam lumber</td><td>Hardwood lumber</td><td>Softwood lumber</td><td>Oriented strandboard</td><td>Non structural panels (average)</td><td>Hardwood veneer / plywood</td><td>Particleboard / medium density fiberboard</td><td>Hardboard</td><td>Insulation board</td><td>Other industrial products</td><td>Paper</td></tr>
<tr><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td><td>(X%)</td></tr>
<tr><td>(3A)</td><td>(3B)</td><td>(3C)</td><td>(3D)</td><td>(3E)</td><td>(3F)</td><td>(3G)</td><td>(3H)</td><td>(3I)</td><td>(3J)</td><td>(3K)</td></tr>
<tr><td>0.521</td><td>0.554</td><td>0.639</td><td>0.696</td><td>0.592</td><td>0.521</td><td>0.521</td><td>0.521</td><td>0.521</td><td>0.521</td><td>0.151</td></tr>
<tr><td>(4A)</td><td>(4B)</td><td>(4C)</td><td>(4D)</td><td>(4E)</td><td>(4F)</td><td>(4G)</td><td>(4H)</td><td>(4I)</td><td>(4J)</td><td>(4K)</td></tr>
</table>

Sum the row values of 4A-K to get the total current wood products value. Add this to the previous years' sum to carry forward. For example, if you have 10,000 tons from previous years and 3,000 tons this year, carry forward 13,000 tons in the wood products pool. Since the values incorporate a 100-year decay value there is no need to make further adjustments with time.

Step 10 – Sum Carbon Pools

Table A.8. Worksheet for Summarizing Carbon Pools and Calculating Total Carbon

Carbon Pool	Required Pool?	Gross Carbon Tons per Hectare

Step 2 Live Trees	Yes	From sampling results of trees.
Steps 3 – 4 Standing Dead Trees, and Lying Dead Wood	Yes, unless justified	From sampling results of standing dead biomass and lying dead biomass.
Step 6 Shrubs and Herbaceous Understory	Yes, unless justified	From sampling results of shrubs and herbaceous understory.
Step 7 Litter and Duff	Yes, unless justified	From sampling results of litter and duff.
Step 8 Soil	Yes, unless justified	From sampling results of soil.
Section A5 Wood Products	Yes, unless justified	From Board of Equalization Reports and calculations explained in Step 5.
Sum of Carbon Tons from Included Pools		
Computation and Application of Confidence Deduction		
Sum of Carbon Tons from Included Pools Adjusted for Confidence		

Appendix B Modeling Carbon Stocks

This protocol requires the use of certain empirical-based models to estimate the baseline carbon stocks of selected carbon pools within a project's geographic boundary. These models may also be used to supplement assessments of actual changes in carbon stocks resulting from the project activity.

B.1 About models and their eligibility for use in the Reserve

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.

Models used for producing estimates of carbon values provide two basic functions. First, they determine values for existing tree volume and correlated carbon stocks. These include equations that infer tree biomass from diameter measurements.

The equations provided in the preceding sections are pre-approved for use in the Reserve. If project developers or forest entities would like to use equations that are different from those provided in this Protocol, such equations must be equivalent to or more accurate than those provided. This equivalency or greater accuracy must be demonstrated to the Verifier during the verification process. Also, the assumptions applied in the model must be transparent and made available to the Verifier.

The second function of models is the projected results of direct sampling through simulated forest management activity. These models, often referred to as growth simulation models, may project information regarding tree growth 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.

The following growth models have been approved for the states listed.

State	Models Approved
California	▪ 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

The Reserve will include additional models when they can demonstrate to a state forester:

- They have 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
- They must be parameterized for the specific conditions of the project and/or entity land area
- Their use has been limited to the scope for which the model was developed and evaluated
- They must be clearly documented to include the scope of the model, assumptions, known limitations, embedded hypotheses, assessment of uncertainties and sources for equations, data sets, factors or parameters, etc.
- They undergo a sensitivity analysis to assess model behavior for the range of parameters for which the model is applied
- They are periodically reviewed[14]

B.2 Requirements for using models to forecast baseline carbon stocks

The use of simulation models is required for quantifying a project's baseline carbon stocks. .

Inventory information from Appendix A must be incorporated into the simulation models to develop the project baseline, which is a projection of 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.

The baseline 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 project 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.

[14] Prisley, S.P. and M.J. Mortimer. 2004. A synthesis of literature on evaluation of models for policy applications, with implications for carbon accounting. For. Ecol. & Mgt. 198(1-3):89-103.

Appendix C Determination of the Risk Rating for Forest Projects

The worksheets in this section are designed to identify and quantify the risks associated with possible reversals for a specific project. The worksheets will identify a risk-rating that is unique to each project and determine the quantity of CRTs that the project must hold in reserve to insure against reversals. It is expected that project proponents and verifiers will conduct this analysis on a project by project basis and when justified, recommend different values and or mitigations for these calculations. This risk assessment should be updated on the same schedule as project verification.

The mitigated risks in this worksheet are based on a Reserve project with a commitment to a 100-year period. Projects outside of the Reserve that have commitment periods less than 100 years are at a higher level of risk for all elements identified in this worksheet due to the cessation of project monitoring, which is required by the protocols while a project is active. Due to the potential atmospheric impact of projects with less than 100 year commitment (non-Reserve projects), the adjustments to these risk elements need to be severe.

C.1 Financial Risk

Financial limitations keep projects from sequestering and managing obligated reductions. This may occur when net revenues associated with forest management (including carbon management) are less than anticipated to achieve silvicultural objectives. Risk is related to the financial stability of the organization and/or funding organizations. Lack of funding may result in not implementing expected silvicultural activities that enable reductions to be achieved.

Table C.1. Financial Risk Identification.

	Identification of Risk		**Impact of Unmitigated Risk on Carbon Reductions**
FR1	Investment into the project is recouped over a period of 10 years or more. Some reforestation and restoration projects may meet these criteria.		-40%
FR2	Investment into the project is recouped over a period of time less than 10 years and maintenance of the project and/or financial yields are covered by initial expenditures or costs and revenues for a project are estimated to be in balance over time; including all revenues such as timber sales and hunting/grazing leases. Note: publicly financed projects have no financial risk.		0%
FR3	Enter the value that reflects the project's financial risk:		
	Mitigation	**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**
FR4	Organization has demonstrated financial strength over the previous 10 years and funding sources are built in institutionally.	The anticipated expenses are not out of context for the organization	Risk (FR3) * 0%

FR5	Organization has not demonstrated financial strength over the previous 10 years, but can demonstrate funding sources for project are clearly available	The anticipated expenses are out of context for the organization, but funding sources appear reasonable	Risk (FR3) * 25%
FR6	Organization does not have long track record of financial strength and cannot demonstrate that funding sources are clearly available	The anticipated expenses are out of context for the organization and funding sources appear unreasonable	Risk (FR3) * 100%
FR7	Mitigated value of financial risk - Enter the value that reflects the project's mitigated financial risk:		

C.2 Management Risk

Management failure is the risk of management activities directly or indirectly impacting forest stocks that are obligated as permanent reductions.

Table C.2. Management Risk Identification.

Identification of Risk				Impact of Unmitigated Risk on Carbon Reductions
MR1	Project is located in an area where illegal logging occurs frequently and/or the effect is significant on obligated reductions			-50%
MR2	Project is located in an area where illegal logging occurs infrequently and/or the effect is marginal on obligated reductions			-10%
MR3	Project is located in an area where illegal logging almost never occurs and/or the effect is insignificant on obligated reductions			- 0%
MR4	Enter value that reflects project's illegal removals risk:			
Mitigation		**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**	**Mitigated Risk**
MR5	Procedures and infrastructure exist within organization that provides adequate control and enforcement.	Security networks may exist in the form of: 1. Gated roads 2. Patrols – both private and public	MR4 * 75%	
MR6	Procedures and infrastructure do not exist within organization that provides adequate control and enforcement.		MR4 * 100%	
MR7	Mitigated risk of illegal removals – Enter the smallest number from MR5 – MR6			

C.2.1 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.

C.2.2 Management Risk II – Conversion of forestland to other uses that impact current carbon stocking and future sequestration

High values for development to housing and/or agriculture may compete with current 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 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 C.3 displays the likelihood rankings of forest conversions to other uses based on individual attributes. The project area should be stratified into independent land units based on conversion likelihood. A land unit is any portion of the project that could logically be severed from the project boundary. The size of the land units in the analysis should be based on incorporating the following considerations for logical severance: zoning restrictions, ability to rezone, physical and legal barriers, and impact of implementation of conversion on adjacent land units.

The overall estimate for the risk rating that is factored into the project's risk rating is based on a weighted average of the land units. Each land unit will be assessed per the criteria below. The assessment should consider these values into the foreseeable future. Projects that are found within the following categories are considered to have a zero risk of conversion, should demonstrate a conversion likelihood value of zero, and continue to the next risk element:

1. Land units that have current (and for the foreseeable future) legal restrictions that disallow conversion activities. (e.g. conservation easements, deed restriction, or third party contract)
2. Public Lands
3. Avoided Conversion projects with required conservation easement or transfer to public ownership

Table C.3. Risk of conversion rank.

Conversion Rank	Topography	Proximity to population center	Proximity to Local Provisions (Groceries, fuel, supplies)	Population Growth in Area with 5 Hours Drive Time	Costs of Services (electricity, water)	Seasonal Access	Zoning
Highly Likely (2 points each)	0-30% slope	< 3 hours to a population > 500,000	< 30 minutes	Increasing	Developed at < 9.9% of land value	Year-round	Not restrictive to conversion
Moderate Likely (1 point each)	30-45% slope	< 3 hours to a population > 50,000	30 – 60 minutes	Stable	Developed at 10% to 49.9% of land value	3 Seasons	Somewhat restrictive to conversion

Not Likely (0 points)	>45% slope	> 3 hours from a population > 50,000	> 60 minutes	Decreasing	Developed at > 50% of land value	1-2 Seasons	Very restrictive to conversion

Each land unit is assigned an overall conversion ranking based on the following matrix:

Score (from matrix above)	Overall Conversion Ranking
10 – 14	Highly likely
7 – 10	Somewhat likely
3 – 6	Not likely
< 3	Extremely unlikely

Table C.4. Computing the impact of unmitigated risk.

Land Unit Ranking		Likely Conversion Strategy	Impact of Unmitigated Risk on Carbon Reductions
MR8	Project has land units with a **highly likely** rating of conversion	Housing with > 40 acre lots	-10%
		Housing with 5 – 40 acre lots	-30%
		Housing with 1 – 5 acre lots	-50%
		Housing with < 1 acre lots	-70%
		Agriculture/ Industrial/Golf Course	-90%
MR9	Project has land units with a **somewhat likely** rating of conversion	Housing with > 40 acre lots	-10%
		Housing with 5 – 40 acre lots	-20%
		Housing with 1 – 5 acre lots	-30%
		Housing with < 1 acre lots	-40%
		Agriculture/ Industrial/Golf Course	-50%
MR10	Project has land units with a **not likely** rating of conversion	Housing with > 40 acre lots	-0%
		Housing with 5 – 40 acre lots	-10%
		Housing with 1 – 5 acre lots	-20%
		Housing with < 1 acre lots	-30%
		Agriculture/ Industrial/Golf Course	-40%
MR11	Project has land units with a **extremely unlikely** rating of conversion	Housing with > 40 acre lots	-0%
		Housing with 5 – 40 acre lots	-0%
		Housing with 1 – 5 acre lots	-10%
		Housing with < 1 acre lots	-20%
		Agriculture/ Industrial/Golf Course	-30%

Conduct the analysis for each land unit and compute a weighted average for the unmitigated risk percentage for the project area using the matrix below:

Land Unit	Acres	Impact of Unmitigated Risk (MR8 – MR11 above)	Weighting
1	Acres_X	IR_X	Acres_X * IR_X
2	Acres_Y	IR_Y	Acres_Y * IR_Y

3		Acres_Z	IR_Z	Acres_Z * IR_Z
All		Sum of Acres		Sum of Weighting
MR12	**Weighted Impact of Unmitigated Risk of Conversion:**			Sum of Weighting/Sum of Acres

The weighted unmitigated risk (MR12) is multiplied by the multiplier below to compute the mitigated risk (MR16).

Table C.5. Mitigated risk computation.

Mitigation		**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**	**Mitigated Risk**
MR13	Project has no legally recorded document that points to a project commitment	No specific mitigation exists	MR12 * 100%	
MR14	Project has a recorded notice that identifies a contract that restricts changes in ownership or binds successive landowners to project commitments	The recorded notice ‘points’ to the Reserve and restricts changes in ownership or travels with the land, and identifies a contract binding successive landowners to the obligated reductions and monitoring requirements, commensurate with the project commitments, from the project area.	MR12 * 50%	
MR15	Project has a recorded notice and an encumbrance granted to a 3rd party that binds successive landowners to project commitments	The recorded notice identifies an encumbrance granted to a 3rd party for annual monitoring and enforcement, ‘points’ to the Reserve and travels with the land, binding successive landowners, through limits on land uses or required forest management to the obligated reductions and monitoring requirements, commensurate with the project commitments, from the project area. Injunctive relief and specified damages, and requisite funding.	MR12 * 0%	
MR16	Mitigated risk of conversion – Enter the value from MR13 – MR15 that reflects the project:			

C.2.3 Management Risk III – Reducing obligated reductions through over-harvesting

Favorable timber values, among other reasons, may motivate some project managers to realize timber values at the expense of managing obligated reductions. Additionally, reducing obligated reductions can occur as the result of harvest associated with fuels treatments. Timber value as used below is the sum of the individual species stumpage value at any time multiplied by the estimated volume per acre of that species.

Table C.6. Identification of risk of reducing obligated reductions through over-harvesting.

	Description of Scenario	Timber Value	Unmitigated Risk
For public and private lands that engage in regular commercial harvesting activities - State and Federal Parks go to MR23			
MR17	Timber value will exceed $10,000/ acre across the project area within 100 year period	High	-50%
MR18	Timber value will be between $6,000 and $10,000/ acre across project area within 100 year period	Medium High	-40%
MR19	Timber value will be between $4,000 and $6,000/ acre across project area within 100 year period	Medium	-30%
MR20	Timber value will be between $2,000 and $3,000/ acre across project within 100 year period	Medium Low	-20%
MR21	Timber value will be between $1,000 and $2,000/ acre across project area within 100 year period	Low	-10%
MR22	Timber value will be less than $1,000/ acre across project area within 100 year period	Very Low	0%
MR23	Other silvicultural activities that could occur in the project area that might reduce obligated reductions	NA	-10%
MR24	Other silvicultural activities that could occur in the project area but will not reduce obligated reductions	NA	0%
MR25	Unmitigated Over-harvest risk – Enter the value from MR17 to MR22 that reflects the project area and add MR23 or MR24 to this value if necessary		

	Mitigation	Definition/Description of Mitigation Tool	Effect of Tool on Risk	Mitigated Risk
For Public Lands Only				
MR26	Projects are on public lands and management activities are undertaken under a management plan with public review	Projects occur with significant public review and in a transparent manner where climate issues are assessed.	MR25 * 5%	
MR27	Projects are on public lands and management activities are undertaken without a management plan with public review	Projects occur without significant public review and in a manner where climate issues are not directly assessed.	MR25 * 50%	
For Private Lands Only				
MR28	Project has no legally recorded document that points to a project commitment	No specific mitigation exists	MR25 * 100%	

MR29	Project has a recorded notice that identifies a contract that restricts changes in ownership or binds successive landowners to project commitments	The recorded notice 'points' to the Reserve and restricts changes in ownership or travels with the land, and identifies a contract binding successive landowners to the obligated reductions and monitoring requirements, commensurate with the project commitments, from the project area.	MR25 * 25%	
MR30	Project has a recorded notice and an encumbrance granted to a 3rd party that binds successive landowners to project commitments	The recorded notice identifies an encumbrance granted to a 3rd party for annual monitoring and enforcement, 'points' to the Reserve and travels with the land, binding successive landowners, through limits on land uses or required forest management to the obligated reductions and monitoring requirements, commensurate with the project commitments, from the project area. Injunctive relief and specified damages, and requisite funding.	MR25 * 0%	
MR31	Mitigated risk of over-harvesting – Enter the value from MR26 to MR30 that reflects the project:			

C.3 Social Risk

This section addresses social elements which may represent risks to permanence. This section is limited to considerations that are consistent with our national context. That is a stable national government with an established division of authorities provided to independent State and local Government Entities. This section speaks to the risk of those with authority taking actions that will negatively affect the stability of carbon emission reduction projects through ownership, financing, or measurement and validation. The risk of social or political actions or reactions impacting a forest protocol project are low but if a negative event occurs under one of the risk factors the impact on the project can be very significant to the individual project.

C.3.1 Social Risk I - Risk of government changing climate policy

The risk of a government changing climate policy is dependent on the degree of governmental stability and centralized policy development authority. These two factors weigh heavily on choices on the choice of using regulations to reduce emissions versus the use of a cap and trade or offset approach and that choice has a direct affect on investor strategies. Permanence needs to be treated the same across jurisdictions, thus the question of national climate programs versus regional, state, or local programs becomes important; the degree to which the decision making authority for forest protocols is centralized within one entity and the level of the implementing government represented by that entity. The U.S. has established policy making process at all levels of government. The current situation is that those processes are still working towards a National Policy. Regardless, of what the final protocols will entail, these processes will allow a methodology for consolidation that will include some form of grand-fathering or conversion. Thus, the risk of radical shifts is small. With policy developing at the state, regional, and national level the risk of policies developing without strong commonalities is close to zero.

The exception to this is single local government entities. Therefore, where local government entities have developed carbon policies, a 0.5% risk factor is assigned due to a greater potential to include factors not compatible with larger entities.

Table C.7. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR 1	All Projects	0.5%
SR2	No Mitigation Identified – Enter the value that reflects the project's changing policy risk:	

C.3.2 Social Risk II - Frequently changing regulations or guidelines on GHG accounting

Uncertainty is created with regards to benefits realized with a carbon emission reduction project. The most direct risk of this item is creating an atmosphere where investment into a project ceases and therefore the originally anticipated or projected storage is not fully achieved. The secondary risk of frequently changing regulations or accounting guidelines is the removal of investments for maintenance of a forest project which may result in reversal of storage (i.e. fire damage due to a lack of thinning) for a short to medium time period. In this country there is a relatively consistent process used for the development of regulations. A system very similar to one used in California is also used for federal regulation development. The California Registry protocol development process uses a process similar that used for regulatory development. Other levels of government or other responsible registries will be expected to mimic this pattern. Generally it requires 2 years from the time a change in regulation or an accounting principle is envisioned to when it goes into effect. However, there is a slight risk that a government agency or independent registry may take some form of emergency action that would have unintended consequences on project investments.

Accounting principles for carbon projects are being developed in numerous areas and this will continue for some time. However, there is a greater awareness of the need to the ability to trade between these markets. As a result it is highly likely that though the individual markets may use differing methodologies a common factor will be that a ton of carbon will be the same ton of carbon regardless of the market. Thus, the risk the loss of permanence due to trading conflicts is consider very unlikely or zero.

Again, an exception to this is smaller local registries. Here there is a small but slightly greater risk that standards could be changed more frequently and in a manner such that they could not be traded in the larger markets. This is small, so a low risk value of 1% is assigned to local government or other registries covering only local areas.

Table C.8. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR3	All Projects	1%
SR4	No Mitigation Identified – Enter the value that reflects the project's monetary risk:	

C.3.3 Social Risk III - Monetary decisions that impact, hinder, or enable CER projects

Uncertainty is created for the value of the project on cross jurisdictional trades. The protocols for the individual markets may not have similar standards for qualifying a ton against which a CER may be issued. This narrows the size of the market available for an affected project and each CER may have varying value. The risk of non-permanence is greater in markets with low CER values as sufficient value does not exist to fund project maintenance and monitoring. Establishing standards which would apply to all CER markets would assure that all tradable tons are similar in quality and thus value. This maintains an overall higher value on CER's and project sponsors will be less willing to accept project failure. A central authority (national) that validates the ability of accounting protocols to certify "real" tons will make non-permanence a less acceptable outcome. All of the major efforts at protocol development are aware of the need to have a ton equal a ton, regardless of the accounting pathway. Thus the overall risk of not being able to trade amongst registries is low.

Table C.9. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR5	Low-Medium Likelihood - State, Regional, or Nationally developed accounting standards used.	0.0%
SR6	High Likelihood – Project exist within a jurisdiction that has a history not having reciprocal agreements with other jurisdictions.	0.5%
SR7	No Mitigation Identified – Enter the value that reflects the project's monetary risk:	

C.3.4 Social Risk IV - Environmental Justice (health)

Unidentified health impacts on disadvantaged portions of the populations can result in CER project failure, or added costs. The impact of smoke from wildfire is the most frequently mentioned health risk resulting from forest sector projects. The risk of wildfire is addressed separately under this section for all three forest project types. California Registry protocols include the evaluation of co-benefits in project development and verification. The potential health impacts of a project on under represented portions of the population (assessment area) are addressed in project verification. The California Registry approach is consistent with other recognized carbon accounting registries.

Table C.10. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR8	Low – No EJ communities exist within the air basin of the project, or the wildfire risk is low.	0.0%
SR9	Medium – EJ communities exist within the air basin but the wildfire risk is low	0.5%
SR10	High – EJ communities exist within the air basin and wildfire risk is high.	1.0%
SR11	No Mitigation Identified – Enter the value that reflects the project's environmental justice risk:	

C.3.5 Social Risk V - Effects on employment

A negative impact on local or regional employment can result in CER project failure. Forest projects require businesses with particular skills and equipment for project implementation and maintenance. Absent these skills and equipment, the risk of project non-permanence increases. Projects that remove work opportunity required to maintain this infrastructure increase the risk of non-permanence. In general the effect on employment will be short lived. Forests are a natural resource base and if one business, or type of business, fails then others will develop in their place. Therefore, this class of risk is relatively low. Consideration of co-benefits is required in project development and verification. Where a project may have a negative impact on businesses, thus employment, the inclusion of mitigation in the project design or implementation will be considered. It is the maintenance of the working landscape that has the largest impact on businesses that are needed for forest project implementation and maintenance.

Table C.11. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR12	> 25 miles away from a population center of 100,000 or more or the project proponent demonstrates a history of available workforce.	0.5%
SR13	< 25 miles away from a population center of 500,000 or more or the project proponent demonstrates a history of available workforce.	1.0%
SR14	No Mitigation Identified – Enter the value that reflects the project's effects on employment risk:	

C.3.6 Social Risk VI - Environmental perceptions

Social perceptions of significant environmental harm can lead to opposition resulting in CER project delay, costs, or failure. The use of California forests have been a highly contentious topic for at least four decades. As a result an extremely strong set of governmental institutions have been put in place to assure the sustainability of states forest resources. These California institutions address all of the main areas of forest resources including, vegetation, wildlife habitat, water quality, air, and soils. These institutions apply not only to timber harvesting but also to other forest management. Currently, forest protocol projects are not directly regulated.

However, most of the activities used to implement the three types of forest projects are subject to some regulations at the state and or federal level. This provides direct and indirect stakeholders a level of assurance that overall forest health receives protection during the life of a project. Even with these legal assurances concerns and conflict still arise and do hinder or block activities in managing the forest landscape. Working with stakeholders during the planning stages of forest projects is a major means of limiting or reducing conflict and potential delay or blockage of project implementation or maintenance

Table C.12. Social Risk Identification.

Identification of Risk		Impact of Unmitigated Risk on Carbon Reductions
SR15	Low – Maintenance and project implementation rely on non-commercial forest management activities (i.e. Carbon project funds, government incentives, etc.); or commercial projects have a history of general public acceptance in the project assessment area.	0.0%
SR16	Medium – Commercial forest management activities are associated with the maintenance or implementation of the project and there is some organized resistance to these management practices.	0.5%
SR17	High – Commercial Forest management activities are part of the project implementation and maintenance and a history exists of conflict that has resulted in those activities being stopped.	1.5%
SR18	No Mitigation Identified – Enter the value that reflects the project's effects on environmental perceptions risk:	

C.4 Natural Disturbance Risk

In all cases natural disturbances can reverse obligated reductions, but based upon the response those reversals can be reduced and by requiring a project proponent to reforest after such reversals may extend the time period but can make the atmosphere whole in terms of net CO_2. The unmitigated risk values represent best proximate estimates, while recognizing that each of these risks could impact an entire project area, they are also weighted to recognize that over a large area they are rarely very high. There is currently significant research being conducted to better understand ways to reduce natural disturbance risk, management that improves or maintains genetic base for greater resiliency to pests and disease, thinning to improve forest health, effects of reduced fuel loading to moderate fire behavior and management to improve or maintain species diversity to improve forest health and resiliency. This research may lead to other risk reduction mitigations or strategies. California Registry should be open to project proponent- and verifier-confirmed additional risk reduction mitigations. While these potential risk reducing mitigations are studied and developed if a natural disturbance occurs that stops or damages the current forests ability to sequester carbon, reforestation is the fastest way to return a damaged site to net sequestration. Removal and off-site storage can lesson the total amount of obligated ton reductions reversed over time.

C.4.1 Natural Disturbance Risk I – Wildfire

Wildfire has the potential to reverse obligated reductions especially in certain carbon pools. Prompt reforestation has been shown to transform sites back to net sequestration in as little as ten years. Removal and off-site storage and/or other activities to mitigate risk of increased C emissions can arrest the continued reversal of obligated reductions. A well designed and implemented disturbance recovery plan can rapidly help to mitigate the continued reversal of obligated reductions and restore carbon losses through management activities that sustain and reclaim the growth potential of the forest.

Table C.13. Natural Disturbance Risk Identification.

	Identification of Risk			Impact of Unmitigated Risk on Carbon Reductions
ND1	Project is located in an area where demonstrated historical risk to wildfire is very high			-20%
ND2	Project is located in an area where demonstrated historical risk to wildfire is moderate			-10%
ND3	Project is located in an area where demonstrated historical risk to wildfire is low to non existent			- 0%
ND4	Enter the value that reflects the project's wildfire risk:			
Mitigation		**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**	**Mitigated Risk**
ND5	Project proponent makes no allowance for conservation and restoration of project C stocks	No restoration of lost growing stocks reduces past and future reductions No provision for mitigation of increased decay rate from fire losses and increased dead wood	ND4 * 100%	
ND6	Project proponent makes allowance for conservation and restoration of project C stocks	Reforestation, currently not required returns site to net carbon sequestering in shorter period of time Appropriate recovery of trees killed following natural disturbances can minimize and mitigate risk of increased C emissions Management efforts that control stocking (thinning), brush control, and firebreaks	ND4 * 25%	
ND7	Enter Mitigated Wildfire Risk %			

C.4.2 Natural Disturbance Risk II - Disease or insect outbreak

A Disease or insect outbreak has the potential to reverse obligated reductions especially in certain carbon pools. Prompt reforestation if the outbreak is large enough has been shown to transform sites back to net sequestration in as little as ten years. Removal and off-site storage and/or other activities to mitigate risk of increased C emissions can arrest the continued reversal of obligated reductions. A well designed and implemented disturbance recovery plan can rapidly help to mitigate the continued reversal of obligated reductions and restore carbon losses through management activities that sustain and reclaim the growth potential of the forest.

Table C.14. Natural Disturbance Risk Identification.

Identification of Risk				Impact of Unmitigated Risk on Carbon Reductions
ND8	Project is located in an area where demonstrated historical risk to epidemic disease or insect outbreak is very high			-10%
ND9	Project is located in an area where demonstrated historical risk to epidemic disease or insect outbreak is moderate			-5%
ND10	Project is located in an area where demonstrated historical risk to epidemic disease or insect outbreak is low to non existent			- 0%
ND11	Enter the value that reflects project's disease and insect risk:			
Mitigation		**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**	**Mitigated Risk**
ND12	Project proponent makes no allowance for conservation and restoration of project C stocks	No restoration of lost growing stocks reduces past and future reductions No provision for mitigation of increased decay rate from insect and disease losses and increased dead wood	ND10 * 100%	
ND13	Project proponent makes allowance for conservation and restoration of project C stocks	Reforestation, currently not required returns site to net carbon sequestering in shorter period of time Appropriate recovery of trees killed following natural disturbances can minimize and mitigate risk of increased C emissions Management efforts such as thinning of suppressed trees/decadent trees and brush control that maintain vigorous growth	ND10* 25%	
ND14	Enter Mitigated Disease and Insect Risk %			

C.4.3 Natural Disturbance Risk III - Other episodic catastrophic events

A major wind-throw event (hurricane, tornado, simply high wind event) has the potential to reverse obligated reductions especially in certain carbon pools. Prompt reforestation if the episodic catastrophic event is large enough has been shown to transform sites back to net sequestration in as little as ten years. Removal and off-site storage and/or other activities to mitigate risk of increased C emissions can arrest the continued reversal of obligated reductions.

A well designed and implemented disturbance recovery plan can rapidly help to mitigate the continued reversal of obligated reductions and restore carbon losses through management activities that sustain and reclaim the growth potential of the forest.

Table C.15. Natural Disturbance Risk Identification.

Identification of Risk				Impact of Unmitigated Risk on Carbon Reductions
ND15	Project is located in an area where demonstrated historical risk to large area wind-throw events (hurricane, tornado, high winds) is high.			-10%
ND16	Project is located in an area where demonstrated historical risk to large area wind-throw events (hurricane, tornado, high winds) is moderate			-5%
ND17	Project is located in an area where demonstrated historical risk to large area wind-throw events (hurricane, tornado, high winds) is low to non existent			- 0%
ND18	Enter value reflect project's episodic catastrophic risk:			
Mitigation		**Definition/Description of Mitigation Tool**	**Effect of Mitigation Tool on Risk**	**Mitigated Risk**
ND19	Project proponent makes no allowance for conservation and restoration of project C stocks	No restoration of lost growing stocks reduces past and future reductions No provision for mitigation of increased decay rate from other episodic catastrophic event losses and increased dead wood	ND18 * 100%	
ND20	Project proponent makes allowance for conservation and restoration of project C stocks	Reforestation, currently not required returns site to net carbon sequestering in shorter period of time Appropriate recovery of trees killed following natural disturbances can minimize and mitigate risk of increased C emissions	ND18 * 25%	
ND21	Enter Mitigated Other Risk %			

C.5 Summarizing the Risk Assessment

Risk Element		**Risk Rating**
FR7	Financial Failure	
MR5	Illegal Removals of Forest Biomass	
MR16	Conversion	
MR31	Over-Harvesting	
SR2	Government Changing Climate Policy	

SR4	Changing Regulations of Guidelines on GHG Accounting	
SR7	Monetary Decisions that Impact, Hinder, or Enable CER Projects	
SR11	Environmental Justice	
SR14	Effects on Employment	
SR18	Environmental Perceptions	
ND7	Wildfire	
ND14	Pests	
ND21	Other	
	Overall Project Risk Rating (Sum of all independent mitigated risks based on 100 year project commitment)	

Appendix D Native Forests Resources

State	References
California	Jepson Flora Project, which may be accessed on-line at: http://ucjeps.berkeley.edu/jepsonflora/.