Yurok Tribe

Sustainable Forest Project

CAR 777

Project Design Document

Climate Action Reserve

Forest Project Protocol v3.1

Improved Forest Management

Initial Verification

Final Version

June 27, 2013

Ecotrust Forest Management, Inc.

Contents

1. Introduction

The Yurok Tribe Sustainable Forest Project (CAR777) is an Improved Forest Management (IFM) project that is seeking registration under the Climate Action Reserve (CAR) Forest Project Protocol version 3.1 (FPP v3.1). The project site is on private land owned in fee by the Yurok Tribe of California.

a. Yurok Tribe

The Yurok Tribe is currently the largest Tribe in California, with more than 5,000 enrolled members. The Tribe provides numerous services to the local community and membership with its more than 200 employees. The Tribe's major economic and natural resource initiatives include: fisheries protection, restoration and management, dam removal, natural resources protection, sustainable economic development enterprises and land acquisition. The Yurok Tribe is the landowner and will implement the Yurok Tribe Sustainable Forest project.

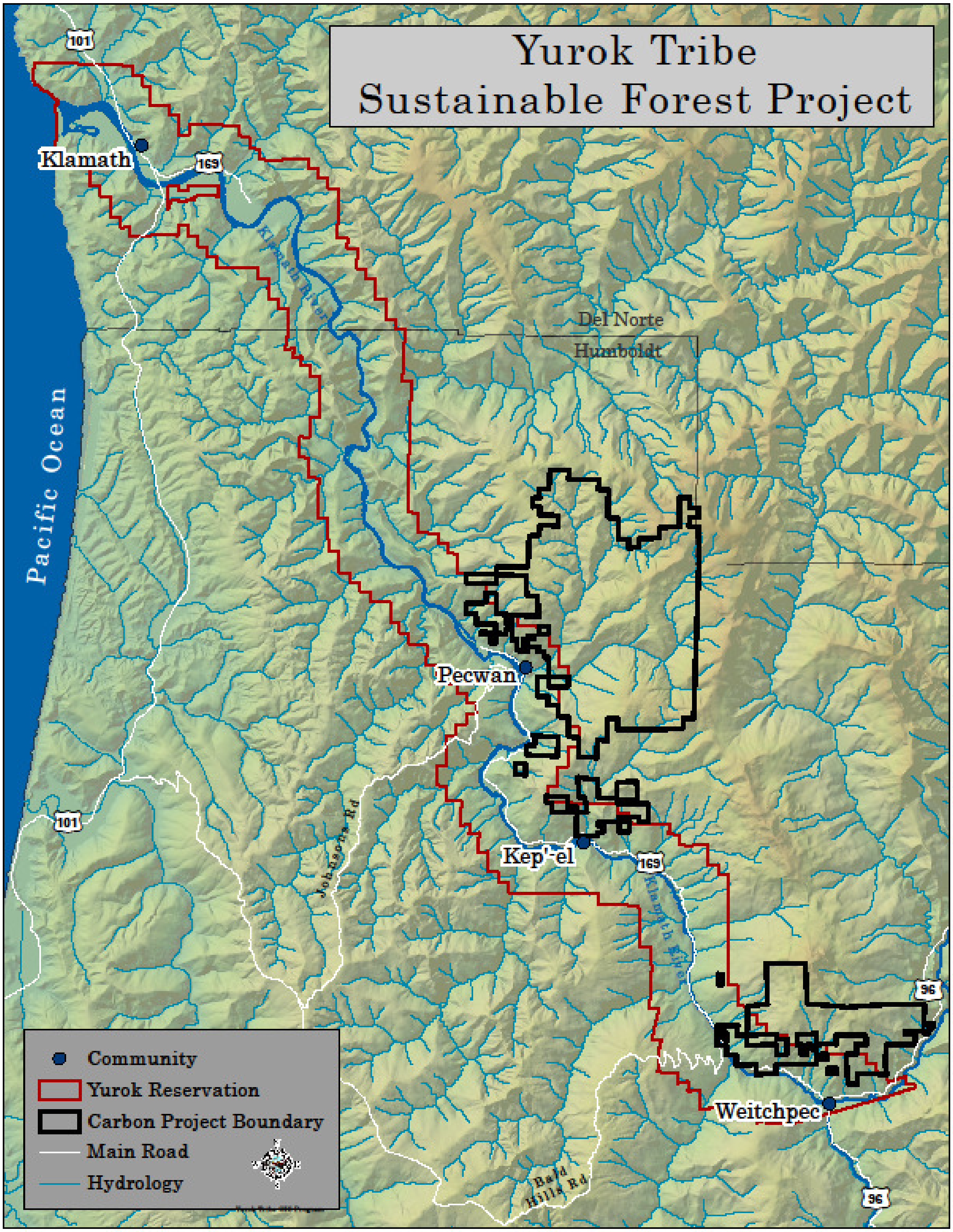
The Yurok Tribe Sustainable Forest Project is located on fee lands owned by the Yurok Tribe in areas within and adjacent to the Yurok Indian Reservation (YIR). The YIR was created by the Hoopa-Yurok Settlement Act of 1988, and is composed of the former Klamath River Reservation and Hoopa Extension. There are approximately 56,000 acres in the entire YIR, and of these, approximately 3,320 acres are held by the United States in trust for the Tribe. The Project Area is on newly acquired land owned in fee that lies both within and outside of the YIR.

b. Project Site Acquisition

In an effort to repatriate historical lands and to protect fisheries and natural resources within tribal lands and the state of California, the Yurok Tribe partnered with Western Rivers Conservancy to acquire several tracts of land from Green Diamond Resource Company. These lands (known as the Phase I Acquisition) are subdivided into three separate management tracts, 1) Pecwan, 2) Cappell (Kep'-el), and 3) Weitchpec (Map 1).

The Project Area covers all of the lands within the Cappell and Weitchpec management areas, and the large majority of the Pecwan tract. Total area of the project site as determined by lot acreage is 21,240.5 acres.

Map 1: Yurok Tribe Reservation and Project Site



c. Other Forest Carbon Project Partners and Roles

In addition to the Yurok Tribe, two partners participated in the development of the project and the materials presented in this Project Design Document (PDD). Each group had different roles throughout the project development process as described below.

i. Ecotrust Forest Management (EFM)

Ecotrust Forest Management offers business advisory and forestland investment management services to clients seeking triple bottom lines returns from forestland investments. EFM leverages the significant capacity that its parent organization, Ecotrust, has in GIS analysis, forest growth and yield modeling, and carbon project development. EFM is responsible for overall project technical support during all phases of the project development, as well as the drafting of the project design document.

ii. ecoPartners (EP)

ecoPartners works with project developers, forest owners and verification bodies to build successful forest carbon offset projects. EP specializes in the technical aspects of project design, planning and development: including accounting methodologies, forest biometrics and remote sensing. The team has experience validating and verifying projects under the Climate Action Reserve (CAR), Verified Carbon Standard (VCS), and the Climate Community & Biodiversity (CCB) standards. On this project, ecoPartners designed and managed the final inventory, completed baseline and project scenario carbon modeling (summarized in inventory and modeling documents provided as Supplements to this PDD), and provided technical support for the office and site visits during verification.

d. Project Design Document format

This Forest Project Design Document (PDD) utilizes the most recent Template developed by the Climate Action Reserve (CAR) and uploaded to the CAR website on April 5, 2012. Additional supporting documents referred to throughout the text have been included as separate Supplements A – N. In all cases equations, eligibility requirements, supporting data, and other materials have been drafted to conform to the IFM requirements under CAR FPP v3.1.

2. Project Eligibility

a. Project Type (CAR FPP v3.1 Section 2.1)

REQUIRED: *Provide information about how the project meets the forest project definition and all requirements set forth in Section 2 of the CAR FPP v3.1. Improved Forest Management (IFM) projects should show how they meet the requirements of Section 2.1.2.*

The Yurok Tribe Sustainable Forest Project (CAR777) is an IFM project that is seeking registration under CAR FPP v3.1.

This project meets all four requirements set forth in CAR FPP v3.1, p. 4, Section 2):

1. ***The project takes place on land that has greater than 10 percent tree canopy cover***

The Yurok Tribe GIS team has developed a series of maps (see Supplement A – Project Maps) to meet a variety of geographic information requirements of the CAR FPP v3.1. To demonstrate the required canopy cover of the project site, Maps 3, 4, and 5 in Supplement A trace the project boundaries of the three main management areas on recent aerial photography.

- Supplement A – Map 3: Phase 1 Cappell (Kep'-el) Aerial Photo
- Supplement A – Map 4: Phase 1 Pecwan Aerial Photo
- Supplement A – Map 5: Phase 1 Weitchpec Aerial Photo

These maps demonstrate that the majority of the project site is forested, a fact that has been confirmed by site visits during the verification.

2. ***The project employs natural forest management***

This project meets all the requirements for natural forest management as described in detail within "Section 2.i – Natural Forest Management" of this PDD (CAR FPP v3.1 Table 3.2, pp. 13-14).

3. ***The project does not employ broadcast fertilization***

Management practices on the Project Site do not utilize broadcast fertilization as stated in Supplement H – Summary Management Plan, p. 6.

4. ***The project does not take place on land that was part of a previously registered Forest Project***

The project site was never part of a previously registered Forest Carbon Project under any recognized voluntary or regulatory protocol.

b. Project Location (CAR FPP v3.1 Section 3.8)

REQUIRED: *Describe the project location and the project's boundaries. Provide maps that detail public and private roads, towns, major watercourses, topography, townships, ranges, and sections or latitude and longitude. Further, describe (maps optional) the existing land cover and land use, forest vegetation types, site classes, and land pressures and climate zone/classification. Provide documentation demonstrating approval for the project, if necessary. The Project Location must satisfy the requirements of Section 3.8 of the Protocol.*

According to Section 3.8 of the FPP v3.1, all IFM Projects may be located on private, state, or municipal lands. This protocol also requires that Forest Projects in tribal areas must demonstrate that the land within the Project Area is owned by a tribe or private entities. The Yurok Tribe Sustainable Forest project meets this requirement as all lands within the Project Area are privately owned by the Yurok Tribe (see Attestation of Title Form).

"Supplement A – Project Maps" contains a series of maps that meet the specific requirements for Project Location. The bulleted list below indicates the specific map that fulfills each requirement. In addition to maps, descriptive geographic information is included for those cases where maps were not the best tool to demonstrate compliance with requirements for IFM projects.

MAPS

- ***Project Boundaries*** – Map 1: Project Site with Public and Private Roads, Towns, and Hydrology
- ***Public and Private Roads*** – Map 1: Project Site with Public and Private Roads, Towns, and Hydrology
- ***Towns*** – Map 1: Project Site with Public and Private Roads, Towns, and Hydrology
- ***Major Watercourses*** – Map 6: Detailed Hydrology
- ***Topography*** – Map 7: Topography
- ***Townships, Ranges, and Sections or Latitude and Longitude*** – Map 8: Township, Range, Section
- ***Land Cover and Land Use*** – Map 9: Land Use and Management Areas
- ***Forest Vegetation Types*** – Map 10: Vegetation
- ***Site Classes*** – Map 11: Site Index (Site Class)

DESCRIPTIONS

- ***Land Pressures***

Land conversion pressures are minimal since the property is adjacent to public land (US Forest Service) on the east side and is zoned for forest management in adjacent properties. Because of this zoning, development of property within the project site for residential, commercial or other uses is severely restricted according to California State Law.

- ***Climate Zone***

The project site is found within the Dry Summer Sub-Tropical or Mediterranean Climate Zone (Cs) as defined by the Köppen-Geiger Climate Classification System.[1]

c. Project Area (CAR FPP v3.1 Section 4)

REQUIRED: *The Project Area must be defined according to the requirements of Section 4 of the Protocol.*

Map 2 outlines the project site with a total lot acreage of 21,240.5 acres. Prior to determination of the Project Area lot acreage, various calculations and modeling were conducted based on GIS acreage for both the Phase I acquisition and the subset of that land composing the Project Area. To the extent there is a discrepancy between GIS and lot acreage calculations, an appropriate adjustment ratio was applied for project data.

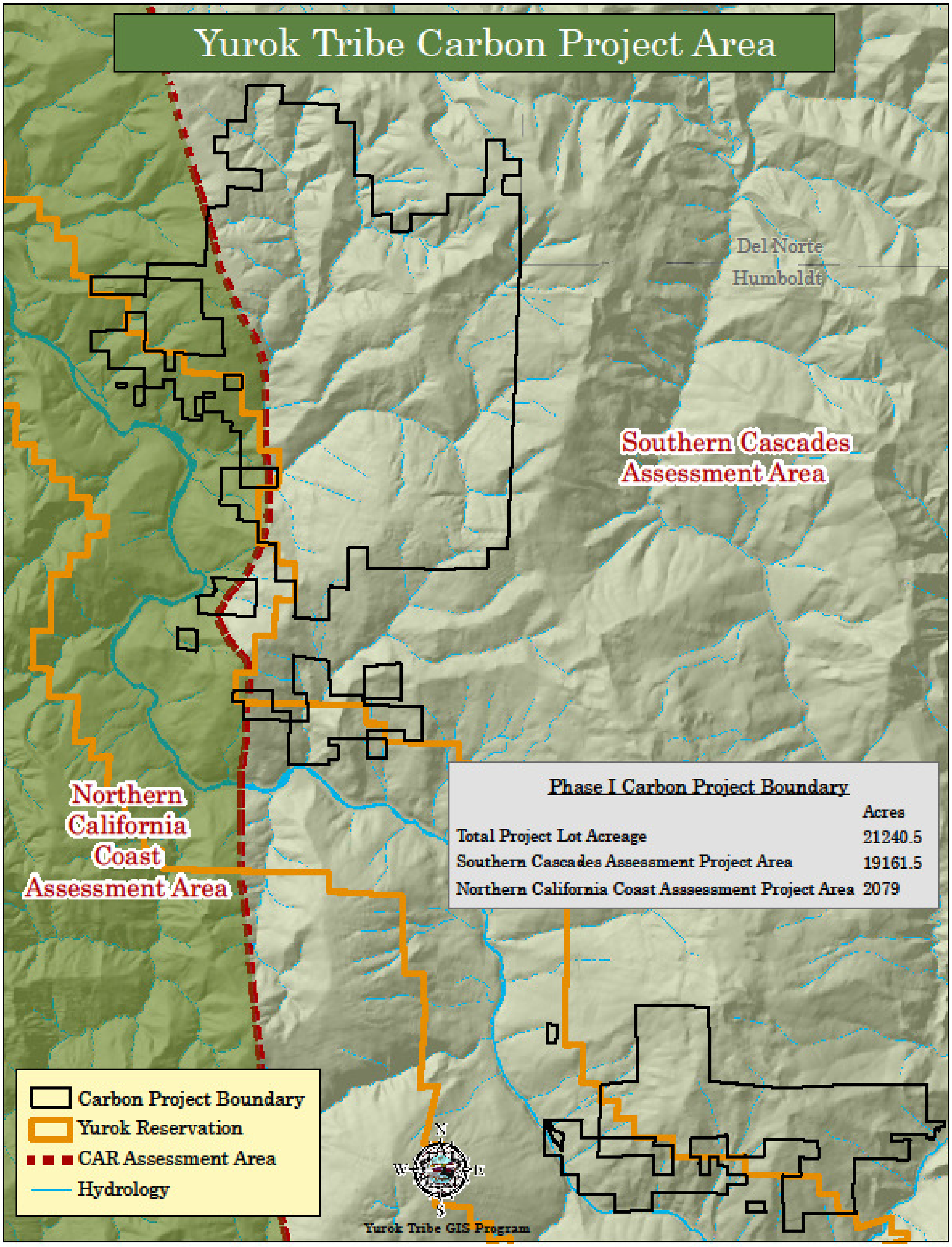
Section 4 of the FPP v3.1 states the following requirements for IFM projects:

1. ***Geographic boundaries of the Project Area must be described in detail at the time the Forest Project is listed on the reserve***

The project area has been mapped using ArcGIS software by the Yurok Tribe GIS Department (see Map 2 below and Supplement A – Project Maps). Detailed survey data, APN lists, zoning data, and title reports are available and will be provided to verifiers during the site and office visit.

[1] Kottek et al. *World Map of the Köppen-Geiger Climate Classification updated,* Meteorologische Zeitschrift, Vol. 15, No. 3, 259-263 (June 2006)

Map 2: Detail of Project Site and Assessment Areas



2. ***Geographic boundaries of the Project Area must not extend beyond the boundaries of an Assessment Area (Supersection) by more than 10% of the Forest Project's Total Area.***

The Project Area extends over two different mapped Supersections, the Northern California Coast and the Southern Cascades. Map 2 shows the Supersection boundary dividing these two supersections, the project boundary, and the total GIS acreage of the Project Area found within each Supersection.

Total Project Area = 21,240.5 acres
10% of the Project Area = 2,124 acres
Project Area in the Northern California Coast Supersection = 2,079 Acres

Since the project area that overlaps the Northern California Coast Supersection is less than 10% of the total Project Area, as shown above, this project meets the eligibility requirement for geographic boundaries and supersections, and this project will be evaluated as falling completely within the Southern Cascades supersection.

d. Additionality–Legal Requirement Test (CAR FPP v3.1 Section 3.1.1.2)

REQUIRED: *Indicate that the Forest Project is not legally required, and was not legally required at the time of the Project's Start Date.*

Management actions across the project site that will result in additional carbon sequestration and storage are not legally required and were not legally required at the Project Start Date. The Yurok Tribe will sign the Regulatory Attestation form stating that the management activities employed at the Project Start Date and during the lifetime of the project are not required by law.

e. Additionality – Performance Standard Test (CAR FPP v3.1 Section 3.1.2)

REQUIRED: *Demonstrate that the project meets the Performance Standard Test.*

All IFM projects are considered to meet the performance standard for additionality, as per the CAR 3.1 FPP, Section 3.1.2.2, p. 7.

f. Broadcast Fertilization

REQUIRED*: Explicitly state that the project will not utilize broadcast fertilization.*

Management on the Yurok Tribe Sustainable Forest project area does not utilize broadcast fertilization as stated in Supplement H – Summary Management Plan, p. 6.

g. Project Start Date (CAR FPP v3.1 Section 3.2)

REQUIRED: *Provide an explanation of and justification for the Project Start Date, according to Section 3.2 of the Protocol. Please provide supporting documentation and evidence supporting the action designating the date as a Project Start Date.*

The FPP v3.1 defines the project start date for all Improved Forest Management projects as:

the initiating of forest management activities that increase sequestration and/or decrease emissions relative to the baseline (CAR FPP v3.1, p. 8).

The Project Start date is April 14, 2011, the date on which the Yurok Tribe took ownership of the property. At that time the Yurok Tribe Forestry Department began managing the site in conformance with the management objectives of the Tribe, which includes additional storage of carbon. The date of title transfer from Western Rivers Conservancy to the Yurok Tribe is demonstrated by the Transfer of Title document included as Supplement C – Title Transfer and the Attestation of Title form.

h. Sustainable Harvesting Practices (CAR FPP v3.1 Section 3.9.1)

REQUIRED: *At the time commercial harvesting is either planned or initiated within the Project Area describe how the project meets the Sustainable Harvesting Practices requirement through one of the three options described in Section 3.9.1.*

All Improved Forest IFM projects must demonstrate that they employ sustainable harvest practices on the Project Area through one of the three following ways (FPP v3.1 Section 3.9.1, pp. 11-12):

1. *The Forest Owner must be certified under the Forest Stewardship Council, Sustainable Forestry Initiative, or Tree Farm System certification programs.*
2. *The Forest Owner must adhere to a renewable long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by a state or federal agency.*
3. *The Forest Owner must employ uneven-aged silvicultural practices and canopy retention averaging at least 40% across the forest as measured on any 20 acres within the entire forestland owned by the Forest Owner.*

This project meets the second requirement above by following a management plan that will be monitored by the United States Bureau of Indian Affairs (BIA), a federal agency.

Pursuant to a Cooperative Agreement with the BIA, the California Department of Forestry and Fire Protection, the California North Coast Regional Water Quality Control Board, and the California State Water Resources Control Board, the Yurok Tribe currently manages the Project Area according to its BIA-approved 1996 Forest Management Plan (FMP) (Supplement F – BIA Management Plan). This BIA-approved 1996 FMP has been extended through 2012 (see Supplement G – BIA Extension Letter). In addition, for off-reservation portions of the Project Area the Tribe will comply with applicable provisions of the California Forest Practices Act.

While the 1996 FMP is sufficient to meet CAR FPP v3.1 requirements, the Yurok Tribe pursuant to CAR guidance is not formally required to demonstrate compliance at this time. The Yurok Tribe has not submitted a formal harvest plan to California or federal agencies for the Project Area. No harvesting has occurred in the area from the Project Start Date to the current date. Following Section 3.9.1 of the CAR FPP v3.1, at such time as harvesting is planned within the Project Area, the Yurok Tribe will adhere to a long-term management plan that demonstrates harvest levels which can be permanently sustained over time and that is sanctioned and monitored by the BIA.

The Yurok Tribe has further developed a Summary Management Plan (Supplement H), which briefly describes the management of Tribal lands. This document summarizes the different management goals and legal restrictions for each category of land owned and managed by the Tribe, as well as harvest level requirements that can be permanently sustained over time. The Yurok Tribe is currently developing a comprehensive forest management plan governing all Tribal forest lands. That plan will be sanctioned and monitored by the BIA and is scheduled for adoption by 2013.

i. Natural Forest Management (CAR FPP v3.1 Section 3.9.2 Table 3.2)

i. Native Species

REQUIRED: *Describe the native species within the Project Area and provide the quantification required to show that at least 95% of the carbon in the standing live carbon pool is composed of native species.*

All species on the project site are native to the region. A detailed breakdown of ratios of species on the site is listed in Table 1.

ii. Composition of Native Species

REQUIRED: *Describe how the project meets this requirement based on the Composition of Native Species percentage value provided in the Assessment Area Data File for the appropriate Project Assessment Area(s). Variances may be granted for this requirement at the Reserve's discretion.*

Within each Ecoregional Assessment Area there is a maximum percentage that any one species can attain. As stated in section 2.c.2 of this PDD, this project lies within the Southern Cascades Supersection and contains a mix of species that place the project site within the Southern Cascades Mixed Conifer Assessment Area. According to data provided by CAR, the maximum percentage (measured in basal area) that any one species can attain in this Assessment Area is 65%.

Taking values from our final forest inventory (Supplement E – EP Inventory Report v2.8), ecoPartners calculated the total basal area by species for the entire project site and compared this to the total basal area to provide a percentage total for each (ft^2/acre). Table 1 provides these results and demonstrates that no single species exceeds 65% of the overall basal area.

Table 1: Basal Area and Basal Area % by species on project site

Species	Basal Area (ft^2/acre)	Percentage by Basal Area
Douglas-fir	55.02	33.43%
Tanoak	36.78	22.35%
Red Alder	19.18	11.65%
Chinkapin	16.63	10.10%
Pacific Madrone	11.61	7.06%
Western Hemlock	4.75	2.88%
Pepperwood/California Laurel	3.32	2.02%
Coast Redwood	3.32	2.02%
Bigleaf Maple	2.71	1.64%

Black Oak	2.65	1.61%
Port Orford Cedar	2.23	1.36%
Western Red Cedar	1.99	1.21%
Ponderosa Pine	1.78	1.08%
Sugar Pine	1.55	0.94%
Incense Cedar	0.76	0.46%
Unknown	0.15	0.09%
Western White Pine	0.05	0.03%
Knobcone Pine	0.05	0.03%
Jeffrey Pine	0.03	0.02%
White Fir	0.02	0.01%
Other Hardwood	0.00	0.00%
TOTAL	**164.57**	**100.00%**

(Supplement E – EP Inventory Report v2.8, Section 9.5 Table 5, p.12)

iii. Distribution of Age Classes

REQUIRED: *On a watershed scale up to 10,000 acres (or the project area, whichever is smaller), all projects must maintain or make progress toward maintaining, no more than 40% of forested acreage is in ages less than 20 years.*

Pursuant to section 3.9.2 of the Forest Project Protocol 3.1, Table 3.2, certain criteria are specified to test if a Forest Project meets the requirements for percent area in age classes less than 20 years.

The estimator for the proportion of the project area in age classes less than 20 years is

$$p_{AC} = \frac{1}{n_{MPS}} \sum_{i \in \mathcal{P}_{MPS}} y_{AC\,i} + \frac{1}{n_{PCS}} \sum_{k \in \mathcal{P}_{PCS}} z_{AC\,k}$$

where n_{PCS} is the number of plots in the Pre-Cruise area on which a site tree was measured, $\mathcal{P}_{PCS}$ is an index set to plots in the Pre-Cruise area on which a site tree was measured, n_{MPS} is the number of measurement plots in the Cruise area on which a site tree was measured, $\mathcal{P}_{PCS}$ is an index set to measurement plots in the Cruise area on which a site tree was measured, $y_{SC\,i}$ is equal to one if the age of the measured site tree in the Cruise area was less than 20 years and $z_{SC\,k}$ is equal to one if the age of the measured site tree in the Pre-Cruise area was less than 20 years.

Using site tree data, ecoPartners calculated the total percent area for the project site with age classes less than 20 years at 6.9% (see Supplement E – EP Inventory Report v2.10, Appendix M).

iv. Structural Elements

REQUIRED: *Describe the quantification of standing and lying deadwood, and compare it to the requirements provided in Table 3.2.*

All forest owners must ensure that lying dead wood is retained in sufficient quantities. The requirement is different depending on whether portions of the Project Area have recently undergone salvage harvesting. Since all previous timber harvest plans harvests on the project site were completed prior to acquisition (see Supplement N – Timber Harvest Plan Data), the Yurok Tribe must:

> *maintain (or demonstrate ongoing progress toward) an average of at least:*
> - *one (1) metric ton of carbon (C) per acre; or*
> - *1% of standing live carbon stocks,*
>
> *in standing dead wood, whichever is higher, if a verifier determines that the quantity of lying dead wood is commensurate with recruitment from standing dead trees (i.e. there is no evidence that lying dead wood has been actively removed)*

Since downed woody debris was not included as one of the carbon pools to be measured within the carbon inventory, we have met this requirement by calculating the total percentage of carbon coming from the standing dead wood pool.

The estimator of total carbon stocks in standing dead wood is

$$\tau_{SD} = a_{REG}\left[\frac{p}{n_{MP}}\sum_{i\in\mathcal{P}_{MP}} y_{SD\ i} + \frac{\hat{r}(1-p)}{n_{BA}}\sum_{j\in\mathcal{P}_{BA}} f(x_j)\right] + \frac{a_{PC}}{n_{PC}}\sum_{k\in\mathcal{P}_{PC}} z_{SD\ k}$$

where $\hat{r}$ is the estimated ratio of carbon in standing dead wood

$$\hat{r} = \frac{\bar{y}_{SD}}{\bar{y}}$$

and $y_{SD\ i}$ is a plot sample of carbon in standing dead wood from measurement plots, $z_{SD\ i}$ is a plot sample of carbon in standing dead wood from plots in the Pre-Cruise area and $\bar{y}_{SD}$ is the average $y_{SD\ i}$ over all measurement plots.

Pursuant to sections 3.9.2 and 3.9.3 of the Forest Project Protocol 3.1, standing dead should be maintained or enhanced over time. The estimated ratio of carbon in standing deadwood $\hat{r}$ is 0.05920327 (see section 6.5.1 and Appendix N of the EP Inventory Report). The estimated carbon in standing dead wood as a percent of carbon in aboveground live carbon stocks is 6.47% (see EP Inventory Report – Appendix I).

For each standing dead tree in on the measurement and pre-cruise plots, density factors from tables 4-7 in Harmon et al (2011, from http://www.nrs.fs.fed.us/pubs/rp/rp_nrs15.pdf) were used to estimate biomass (see Appendix O). For class D1, the appropriate CAR-approved biomass equation was used while for the other decay classes, the density factors from Harmon et al. were applied to the volume of a frustum of a cone.

j. Ongoing Management Activities (CAR FPP v3.1 Section 3.9.3)

REQUIRED: *Describe the ongoing management activities on the Project Area that will lead to increased carbon stocks in the Project Area compared to the baseline.*

The management activities that will increase carbon stocks on the project site are the extension of rotation age to increase the average age of the forest, extended riparian buffers, and the creation of cultural and ecological reserves.

3. Inventory Methodology

a. GHG Assessment Boundary (CAR FPP v3.1 Section 5)

REQUIRED: *List the sources, sinks, and reservoirs (SSRs) that are included in the Project, according to the requirements listed for IFM Projects as described in Table 5.2.*

The Yurok Tribe Sustainable Forest Project has measured the following carbon pools as described in Table 5.2 in the FPP v3.1, pp. 24-29.

Table 2: Project Carbon Pools (Sources, Sinks, and Reservoirs)

SSR	Description	Required or Optional	Quantification Method
IFM-1	Standing Live Carbon (carbon in all portions of living trees)	Required	Measured through forest inventory and modeled with the Forest Projection and Planning System (FPS)
IFM-3	Standing Dead Carbon (carbon in all portions of dead standing trees)	Required	Measured through forest inventory and modeled with the Forest Projection and Planning System (FPS)
IFM-7	Carbon in in-use forest products	Required	Measured through harvest receipts, modeled with the Forest Projection and Planning System (FPS), and calculated using CAR regional mill efficiency rates, decay rate, and landfill values.

SSR	Description	Required or Optional	Quantification Method
IFM-8	Forest product carbon in landfills	Required (not applied when project harvesting is greater than baseline)	Measured through harvest receipts, modeled with the Forest Projection and Planning System (FPS), and calculated using regional CAR mill efficiency rates, decay rate, and landfill values.
IFM-14	Leakage	Required	Calculated based on harvested wood volumes, wood density values, and biomass equations provided by CAR Forest Project Protocol
IFM-17	Biological emissions from decomposition of forest products	Required	Calculated based on harvest wood volumes, landfill proportions, and mill efficiencies

b. Inventory Design and Sampling Process

REQUIRED: *Describe the inventory design, detailing the year of the inventory, the number of sample plots, dimensions and distribution of the plots, the sampling process, and any stratification either pre or post data collection.*

The Yurok Sustainable Forest project site utilized two different inventories to calculate current carbon stocks on the project site. The first was an inventory designed and completed by Western Timber Services (WTS) at the time of acquisition. The second inventory was designed by ecoPartners (EP) with a specific intent of measuring carbon by creating additional plots that would be added to the earlier Western Timber Services inventory and result in a statistical confidence required by the CAR FPP v3.1.

i. Western Timber Services Inventory (WTS Inventory)

This initial inventory was designed and completed by WTS. The purpose of this inventory was to determine the value of approximately 47,000 acres of timberland in Northwest California. The current project site lies within the boundaries of this 47,000 acre tract. A detailed description of the inventory methods can be found in Supplement D – WTS Inventory Report.

a. Inventory Design

The WTS Inventory utilized nested fixed circular plots.

b. Inventory Year

The WTS inventory was completed in the fall/winter of 2008 with an official completion of December 15, 2008.

c. Number of Sample Plots

The original cruise covering approximately 47,000 acres included 1,147 plots. For the purposes of the Yurok Tribe Sustainable Forest project, of the 1,147 plots, 216 fixed-area plots lying within the project site were used to estimate carbon stocks. These plots were identified by clipping the WTS plot locations to the Pre-Cruise area.

d. Dimensions and distribution

Individual stands within each inventory strata were randomly selected to be cruised. Plots were laid out on a square 6-chain grid.

e. Sampling Process

The data collected for each cruise tree included species, DBH recorded by 1 inch class, number of 16 foot logs to a 6 inch top diameter inside bark, and percent defect by log position. Additional data on selected trees included total height, live crown ratio, defect by bole position (thirds), bear damage code, snag code and age.

The plot data was entered, compiled and processed using proprietary cruise and stand programs of WTS. Tree data collected in the field (species, DBH, merchantable height and visible defect) combined with additional hidden defect, if any, and form class was used to compute the individual tree taper and gross and net volume. All volumes discussed in the report are board feet Scribner, based on 16 foot logs. The WTS program uses the Mason, Bruce and Girard formula for selected tops. Form class was collected at the end of cruise by climbing randomly selected conifers and measuring DBH, DOB at 17.5’ and bark thickness at 17.5’ (all measured to the nearest 10th inch). In total, 385 trees were climbed and measured across the subject property for form class.

Plots were compiled based on the strata and sale unit in which they were located. In cases where samples where light and unrepresentative of the strata as a whole, plots from similar strata were combined. The data were recorded on plot sheets and subsequently digitized by WTS. WTS performed a quality control check on the digital data to identify recordation and transcription errors.

f. Stratification

WTS provided plot data that would be compatible with use of the Forest Biometrics Inc. Forest Projection and Planning System (FPS). FPS is a stand based inventory system, which meant that prior to cruising, the entire tract had to be phototyped into individual polygons or stands and grouped into stand types based on species composition, size/age and stocking level as required for the FPS system. Strata inventoried, groups of stands with similar characteristics, were those identified from aerial photo interpretation and ground truthing to be over 20 years in age and containing merchantable timber.

Stand typing for this project used a 3 character vegetation label using 1 character for dominant species, 1 character for size class (dominant species) and 1 character for stocking level (dominant species). Table 3 summarizes species, size and stocking codes used for phototyping.

Table 3: Cruise Strata --Western Timber Services Cruise -- December 2008

Species for Stand Typing		Size Class		Stocking Level	
R	Redwood	1	≤ 4" DBH	1	0-40%
D	Douglas-fir	2	4"- 11" DBH	2	41-70%
C	Mixed Conifer	3	12"- 21" DBH	3	71-100%
P	Mixed Pine	4	≥ 22" DBH		
H	Hardwood				
A	Alder				
Non-Cruise Types					
XXX	± 10 year or younger, even aged stand, result of clearcut, rehab, etc.				
XXO	± 10-20 year even aged stand, result of clearcut, rehab, etc.				
XBR	Brush				
XGR	Grass				
XRB	River Bar, including river channel				
XRK	Rock (e.g., rock pits, quarries, etc.)				
XWB	Water Body (e.g., pond, small lake, etc.				

In this classification system, R32 would be a redwood dominant stand, size class 11 – 21" DBH, stocking level of redwood 41-70%. The species listed is the dominant species and the stocking level applies only to the dominant species. There were 40 strata in total of non-timber, pre-merchantable and merchantable timber consisting of 1,177 individual stands established across the entire 47,000 acres of the original inventory area.

After the entire project area was phototyped, digitized and type calls were made, individual cruise stands within each merchantable strata were selected using random number generation. Each stand was assigned a unique identifying number and the acreage for each stand was calculated using GIS.

ii. ecoPartners Designed Inventory (EP Inventory)

The second inventory was designed by ecoPartners with the specific intent of measuring carbon by creating additional plots to supplement the earlier WTS inventory and result in the statistical confidence required by the CAR FPP v3.1.

a. Inventory Design

The project area was divided into the following strata:

- Non-forested areas including roads, streams, rock, water bodies, and grasses.
- Pre-Cruise area (those sampled under the WTS Inventory cruise prior to the EP Inventory carbon cruise)
- Cruise area (sampled for EP Inventory)

The WTS cruise was analyzed to estimate number of sample plots needed to obtain an estimate of the total within ±15% standard error of the mean at the 90% confidence level.

A grid of points with a random origin was generated across the project area, with a resolution appropriate to yield the determined sample size. Points that fell directly in non-forested areas or in the Pre-Cruise area were removed. These points were the approximate center locations of allocated plots in the Cruise area. Every fourth grid (p=0.25) point was designated as "measurement" plot, their complement being "basal area" plots.

- Basal area plots consist of observing tree diameters by two-inch class and by species.
- Measurement plots have a suite of observations including species, diameter, height, merchantability and regeneration.

b. Inventory Year

The EP Inventory data was collected in November and December of 2011.

c. Number of Sample Plots

A total of 108 plots were installed and measured according to the plot allocation defined in Supplement E – EP Inventory Report. Of these 108 plots, 29 were measurement plots and 79 were basal area plots.

d. Dimensions and distribution

Sampling plots were located on a grid with random origins as demonstrated in Appendix A of Supplement E – EP Inventory Report.

e. Sampling Process

On both basal area plots and measurement plots, trees over five inches in diameter and fifteen feet in total height were observed on a point sample with a 20 BAF prism. Both living and dead trees were observed on both types of plots, as long as their diameters are at least five inches and total heights are at least fifteen feet. Table 4 provides a summary of data to be collected in measurement plots.

Table 4: Data collected for measurement plots

Measured Data	Living Trees > 5" DBH & 15'	Dead Tress > 5" DBH & 15'	Commercial Species	Merchantable Size
Diameter (DBH)	*	*	*	*
Diameter (top)		*		
Dead status		*		
Total Height	*	*	*	*
Live Crown Height			*	*
Merchantable Height				*
Taper Height			*	*
Crown Class	*		*	*
Defect				*

To estimate carbon using the approved CAR equations, total tree height for some trees had to be estimated by regression on diameter (see Tree Height Regression – Supplement E – EP Inventory Report).

Green Diamond Resource Company foresters check cruised a large subsample of WTS Inventory plots to ensure the accuracy of tree measurements. A check-cruise was also performed by ecoPartners on 5% of plots in January 2012. ecoPartners performed a quality control check on the data including diameter-height plots by species, diameter distribution plots and logical tests in the data. ecoPartners performed a second quality control check on the digital data prior to analysis. The quality control check included diameter-height plots by species, diameter distribution plots and logical tests in the data.

All details of the inventory design, sample plots and process are detailed in Supplement E – EP Inventory Report.

c. Field Measurement and Plot Monumenting

REQUIRED: *Describe the selection process for inventory point locations and the tools used to monument plots.*

i. WTS Inventory

Randomly selected stands within each inventory strata were cruised. Plots were laid out on a square 6 chain grid. Using the UTM NAD83 coordinates of the plots and handheld GPS receivers (Garmin 60csx or equivalent), the cruiser marked a random point (RP) on road or landing to the cruisers first plot using waypoint averaging. The GPS unit was averaged for at least two minutes before marking the RP waypoint.

If GPS reception is unavailable or poor quality, cruiser photo located RP using features on orthophoto. RP was marked with a “purple” and “white” ribbon. In addition, the stand id was marked on a white flag with the plot number the RP is for, the distance and azimuth to the plot, the date and cruiser’s initials.

Rangefinders were used where practical or else steel tape or string box. All plot centers were marked with a “purple” ribbon tied to a center stake/stick with a “white” and “purple” ribbon above plot center. The white flag was labeled with plot #, date and cruiser’s initials. Flagging with white ribbon was placed between plots and was visible from a chain’s distance between plots.

ii. EP Inventory

Basal Area Plots

Basal area plots consist of variable-radius prism point sample. Prism measurements were taken from plot center using a 20 BAF prism with the prism directly over the center of the plot. The plot was located using a GPS unit and the provided plot coordinate. The actual plot center is different from the provided coordinate. Upon arriving at the plot coordinate, a hat or stick was blindly tossed over the cruiser’s shoulder to establish the actual plot center. This location was monumented by burying a light-weight disk 6-9 inches below the soil surface. The disk is provided with an attached loop to which purple flagging tape has been added to aid in plot center relocation. Purple flagging tape has been hung on shrubs or branches at the plot center to aid in finding locations in the near future.

Measurement Plots
Measurement plots consist of a variable-radius, prism point sample and a single fixed-radius plot with a shared center to be located using the same methods as the basal area plots. The plot center has been monumented using the same procedure as the basal area plots. A detailed description of the sampling methods, sampling intensities, and measurement methods are provided in Supplement I – EP Inventory Field Protocol.

d. Data Management System

REQUIRED: *Describe the organization of data for the project, including the software and tools used to manage and store data, as well as any quality control methods in place.*

All inventory data was compiled in accurately dated tables and databases that are regularly backed up on a local and remote server. Spatial data related to forest inventory plots, strata, and other geographic information will be maintained and managed by the Yurok Tribe GIS department using the latest protocols for data security, metadata, and geodatabase management. Software and tools include Excel, Access and ArcGIS. Quality control methods for forest inventory data include diagnostic plots, statistical tests for outliers and review of field data entry sheets for errors in data recording.

e. Quantification Methodology

REQUIRED: *Describe the methodology for translating the sampling and inventory process into a figure for metric tons CO_2e per acre, including conversion factors and units.*

Carbon in all trees was estimated using approved equations from the CAR. The equations were compiled in a propriety dynamic link library for use in Excel and forest modeling software. Source code is available for inspection during the verification. This source code takes the specified metrics from the approved equations. These equations give estimates in kilograms. These estimates were transformed into metric tonnes of carbon dioxide equivalents by first dividing by 1000, then dividing by 2 (proportion biomass in carbon) and the multiplying by 3.67 (molecular ratio of carbon to CO_2).

Carbon in belowground stocks was estimated using the approved equation in the FPP v3.1, Appendix A.3:

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

To estimate carbon using the approved Climate Action Reserve equations, total tree height for some trees had to be estimated by regression on diameter. Non-linear models of total tree height to diameter for fit by species. The models were fit using the Newton-Raphson method of iteratively reweighted least squares. The selected models and model fit statistics are presented in Appendix H of the EP Inventory Report v2.10. A total of 18 models were fit and applied to those trees in the inventory without total height measurements.

The calculation of carbon relied on the following conversion factors and units:

1 metric tonne = 2,204.6 lbs.

1 lb wood = 0.5 lbs of carbon

1 MBF = 1 thousand board feet

1 MMBF = 1 million board feet

1 tCO_2e = 3.67 tC

f. Inventory Update Process

REQUIRED: *Describe the process for which the Project will update its carbon stocks from year to year. Also specify the schedule for conducting new inventories, how any new inventory plots will be incorporated into the inventory estimate, and how any harvests or disturbances will be addressed. Specify the model used as well as explicitly state that the project will comply with the requirement that any field inventory data used cannot be more than 12 years old.*

According to CAR FPP v3.1, a long-term inventory plan described below is required for continuous monitoring of carbon stocks on the project site:

> *Annual monitoring of Forest Projects is required to ensure up-to-date estimates of project carbon stocks and provide assurance that GHG reductions or removal achieved by a project have not been reversed. Forest Owners must conduct monitoring activities and submit monitoring reports on an annual basis.*
>
> *For Forest Projects, monitoring activities consist primarily of updating a project's forest carbon inventory. The Reserve requires a complete inventory of carbon stocks to be reported each year. This complete inventory must be maintained throughout the time the project is reporting to the Reserve.*
>
> *Prior to the Forest Project's first verification, the Forest Owner must establish a monitoring plan detailing the specific methods that will be used to update the project's forest carbon inventory on an annual basis. The inventory methodology detailed in this monitoring plan must adhere to the guidance in CAR FPP v3.1 Appendix A and B which establish the equations for computing biomass and limits to which computer models can be used in the inventory update process.*
>
> Inventory data are updated annually by:
>
> 1. *Incorporating any new forest inventory data obtained during the previous year*
> 2. *Modeling growth in sample plots using approved growth models and stands table project methods*
> 3. *Updating the forest inventory data for harvests and/or disturbances that have occurred during the previous year. (CAR FPP v3.1 p. 60)*
>
> *The plot data used for defining the estimates for verification must have been sampled within the last 12 years. The scheduling of plot sampling may occur in one time period or be distributed over several time periods. Either approach is acceptable so long as an inventory of the entire*

Project Area (its required carbon pools and corresponding sample plots) is completed within 12-year intervals.

The Yurok Tribe will maintain a current running inventory of carbon stocks as part of their management of the project site. The Yurok Tribe is in the process of updating its forest management plan to include Project Area lands. This updated forest management plan will obtain BIA approval and will be compliant with BIA regulations, including completing at least once every seven years a regular inventory that meets a precision level of 5% error at one Standard Deviation. The high level strategic guidelines for management are documented in Supplement H – Summary Management Plan.

Plots will be re-measured at least every twelve years per Appendix A.3 of the CAR FPP v3.1. Individual trees on measurement plots will be grown using FPS or any other growth model approved by CAR between re-measurements, provided that it has been calibrated to accurately reflect data in earlier modeling exercises. Individual trees on the basal area plots may be grown using the same growth model by taking tree diameters as mid-points in each diameter class. Alternatively, basal area on basal area plots may be estimated using a ratio of basal area growth as predicted on measurement plots in the same stratum. Additional plots may be added to the inventory to improve the precision of estimates.

Upon event of natural disturbance, fire, timber harvest or other event that may alter the carbon stocks in the project area, the affected area will be delineated into appropriate strata and all plots within the affected area re-measured prior to subsequent verification. All affected areas that are greater than two acres will be delineated.

All plots listed as “pre-cruise” in the Yurok Carbon Inventory Report v2.10 are temporary plots measured by Western Timber Services. As temporary plots, they cannot be re-measured in the future. In order to update the carbon inventory for the project in the future new permanent plots will be established. Over time the “pre-cruise” plots will no longer be a part of the overall forest carbon inventory since no plot data can be used for more than 12 years (or 18 years, if the inventory updates meet the sub-sampling minimum confidence level requirements).

All new permanent plots will be established following the inventory methods described in Yurok Carbon Inventory Report v2.10. This continuity of inventory methodology will ensure that “specific methods used to update the forest inventory … follow the inventory methodology approved at the time the project is registered” (CAR FPP v3.1, p. 60).

Data collected from new permanent inventory plots will be incorporated into the overall carbon inventory of the project, following guidelines outlined in section 6.2.4 of the Forest Project Protocol v3.1. by:

1. *Incorporating new forest inventory data obtained during the previous year into the inventory estimate. Any prior permanent plots re-sampled during the previous year will be incorporated into the inventory estimates.*
2. *The Yurok Project will use approved model to “grow” (project forward) prior-year data from existing forest inventory plots to the current reporting year. Guidance for projecting forest inventory plot data will follow the guidance provided in Appendix B.*

3. *Updating the forest inventory estimate for harvests and/or disturbances that have occurred during the previous year by adding required plots in the harvested or disturbed area as needed to maintain confidence levels. It may be necessary to restratify disturbed areas so variance of plot data is minimized and required confidence levels are achieved.*
4. *After the inclusion of new inventory data, an appropriate confidence deduction for the inventory based on its statistical uncertainty will be applied, following the guidance in Appendix A, Section A.4.*
5. *In cases where a new statistical confidence must be calculated, a full verification of the project will take place as per the Forest Project Protocol v3.1 requirements.*

Post-disturbance, any stratum that does not have any plot data will receive new permanent plots to be measured over time. The number of these new plots in all strata will be sufficient to ensure that confidence level requirements of FPP v3.1 are met.

Cruise data will be collected on a regular basis using the Field Measurement Protocol (see Supplement I – EP Inventory Field Protocol). The data will be recorded on plot sheets (see Supplement J & K – Plot Datasheets) and subsequently digitized for permanent storage by the Forestry Department and Yurok Tribe GIS staff. Yurok Tribe staff will perform a quality control check on the digital data to identify recordation and transcription errors.

Carbon in all trees on measurement plots will be estimated using approved equations from the CAR. The equations will be compiled in a propriety dynamic link library for use in Excel and forest modeling software. As part of a continuous inventory and monitoring plan, the Yurok Tribe will supply information listed in Table 5 to verifiers on an annual basis:

Table 5: Verification Reporting

Reported Information	**Supplied documents**
The carbon associated with harvest events in terms of effects on onsite stocks and effects on harvested wood products during the previous year.	• Harvest reports prepared by the Forest Owner • Harvest data submitted to agencies
The carbon associated with forest growth during the previous year	• Estimates of growth provided by Forest Owner. The verifier shall determine if reported growth is reasonable based on professional judgment
Any disturbances that have impacted more than 1% of the project carbon that have occurred within the previous year	• Reports submitted by Forest Owner • Regional and State data identifying disturbance sites

4. Baseline Carbon Stocks (CAR FPP v3.1 Section 6)

a. Improved Forest Management Projects (CAR FPP v3.1 Section 6.2)

i. Legal Constraints (CAR FPP v3.1 Section 6.2.1.1)

REQUIRED: *Describe the legal constraints that could affect baseline growth and harvesting scenarios. For details on what constitutes a legal constraint, please reference Section 6.2.1.1 of the Forest Project Protocol v3.1.*

A requirement of the Forest Project Protocol is the listing of all legal constraints that affect management activities on the Project Area. This listing must demonstrate and describe the constraint and discuss how the constraint will be modeled to ensure that the constraint is respected.

According to the CAR FPP v3.1, the Forest Owner

> *must incorporate all legal requirements that could affect the baseline growth and harvesting scenarios. The standing live carbon stock baseline must represent a growth and harvesting regime that fulfills all legal requirements. Voluntary agreements that can be rescinded, such as voluntary Habitat Conservation Plans (HCPs), Safe Harbor Agreements, rental contracts, and forest certification are not legal requirements (CAR FPP v3.1 p. 48).*

Legal constraints include:

- *Federal, state/provincial, or local government regulations that are required and might reasonably be anticipated to influence carbon stocking over time including, but not limited to:*
    - *Zones with harvest restrictions (e.g. buffers, streamside protection zones, wildlife habitat protection zones)*
    - *Harvest adjacency restrictions*
    - *Minimum stocking standards*
- *Forest practice rules, or applicable Best Management Practices established by federal, state, provincial, or local government that relate to forest management*
- *Other legally binding requirements affecting carbon stocks including, but not limited to, covenants, conditions and restrictions, and other title restrictions in place prior to or at the time of project initiation, including pre-existing conservation easements and deed restrictions, excepting an encumbrance that was put in place and/or recorded less than one year prior to the project start date, as defined in section 3.6 (CAR FPP v3.1, p. 48)*

Management on the site will conform with all applicable state and federal regulations governing timber harvesting and endangered species. On-reservation portions of the Project Area are managed in accordance with the National Indian Forest Resources Management Act under a BIA-approved forest management plan. The Yurok Tribe will comply with applicable provisions of California state law for activities undertaken on off-Reservation portions of the Project Area, including compliance with the California Forest Practices Act.

In addition to applicable state, federal, and tribal regulations, all management will abide by restrictions listed on the property itself. There are currently several categories of encumbrances on the title which could impact land management activities. These can be grouped into the following major categories:

- Oil, gas, hydrocarbon, mineral rights
- Rights of way grants and access easements
- Utility easements

Since these title restrictions do not define clear operational actions that will be undertaken on restricted areas, they are not modeled as part of the baseline carbon calculation. Timber harvest may occur on any of these encumbered areas.

There are no current Timber Harvest Plans (THPs) currently on file for the project site.

There is a voluntary Habitat Conservation Plan (HCP) applicable on the project site; however, FPP v3.1 section 6.2.1.1 (p. 48) states, "Voluntary agreements that can be rescinded, such as voluntary Habitat Conservation Plans (HCPs), Safe Harbor Agreements, rental contracts, and forest certification are not legal requirements".

In its March 22, 2012, email communication, reproduced below, CAR has confirmed that the HCP does not need to be modeled as a legal restriction for the purposes of baseline consideration:

> *Because the Yurok forest project (CAR 777) was submitted under Version 3.1 of the Forest Protocol, the provisions contained therein control. Section 6.2.1.1 discusses Habitat Conservation Plans and notes that "voluntary Habitat Conservation Plans … are not legal requirements" for purposes of calculating the baseline for a forest project. Our position with respect to Version 3.1 of the Forest Protocol has been that all HCPs are voluntary. Moreover, here, where the Yurok tribe voluntarily assumed the HCP as part of its voluntary acquisition of the property (i.e., it wasn't purchased as mitigation), we believe that there was no legal mandate requiring the assumption of the HCP.*

For the parameterization of the modeling of carbon stocks on the baseline and project scenarios, legal constraints in Table 6 were followed.

Table 6: Legal Constraints

Constraint	Description
Stream Class 1	150 ft buffer around Class 1 waterways
Stream Class 2	100 ft buffer around Class 2 waterways
Stream Class 3	50 ft buffer around Class 3 waterways
Stream Class 4	100 ft buffer around Class 4 waterways
NDDB Species	Natural Diversity Database species subject to surveying and habitat and avoidance requirements
Federal List	Subset of NDDB species that are threatened and endangered under federal law; Pacific fisher is only listed species in project area
Wild and Scenic River	1/4 mile zone around Klamath River; clear-cutting not explicitly prohibited

Constraint	Description
	from Wild & Scenic Zone but is not included in the model or the baseline
Road	25 ft road buffer
Northern Spotted Owl Detections	No changes to nesting habitat within 500 ft; no changes to roosting habitat within 1,000 ft
Northern Spotted Owl Territories	500 acres of owl habitat must be maintained within 0.7 miles of NSO detections, and 1,336 acres within 1.3 miles
Salamander Detections	Salamander observations from landowner data
Pacific Fisher Detections	Pacific fisher observations from landowner data
Clear Cut Adjacency	Forest Practice Rules for even-aged silviculture requiring at least 300 feet between harvested units
Stocking Standards	Minimum planting and residual basal area standards of Resource Conservation from the Forest Practice Rules
Restricted Zones	Spatial harvesting limits imposed by the above riparian and wildlife constraints

ii. Financial Constraints (CAR FPP v3.1 Section 6.2.1.3)

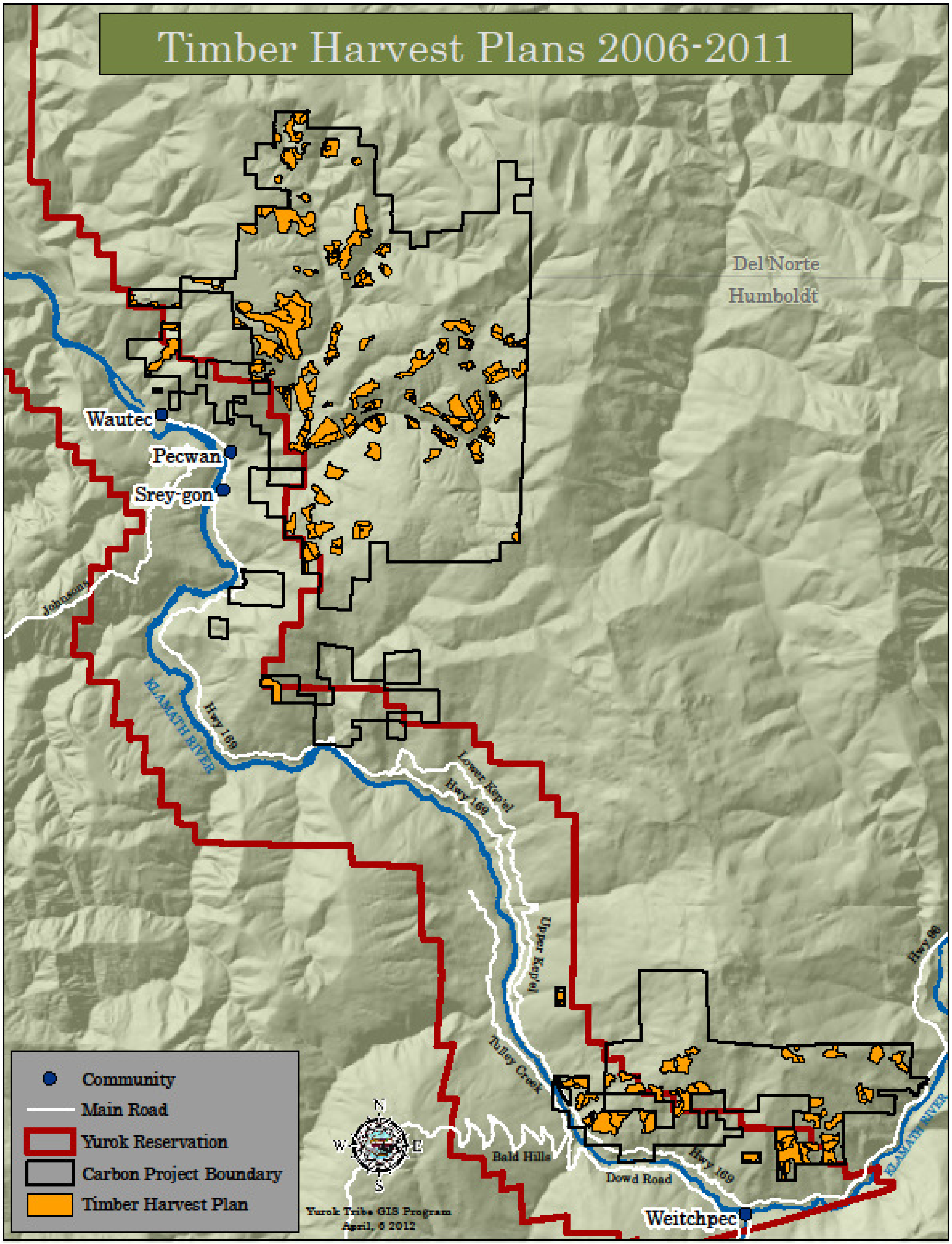
REQUIRED: *Provide either the financial analysis of the anticipated growth and harvesting regime demonstrating financial feasibility or evidence that harvesting has taken place in comparable sites within the project's same Assessment Area. For definitions of what constitutes a comparable site, see Section 6.2.1.3.*

A financially viable baseline modeling can be demonstrated within the CAR FPP v3.1 by

> *Providing evidence that activities similar to the proposed baseline growth and harvesting regime have taken place on other properties within the Forest Project's Assessment Area within the past 15 years. The evidence must demonstrate that harvesting activities have taken place on at least one other comparable site with:*
>
> *a. Slopes that do not exceed slopes in the Project Area by more than 10 percent;*
> *b. An equivalent zoning class to the Project Area*
> *c. Comparable species composition to the Project Area (i.e. within 20% of project species composition based on trees per acre)*
> *d. Similar access by road, cable, or helicopter*

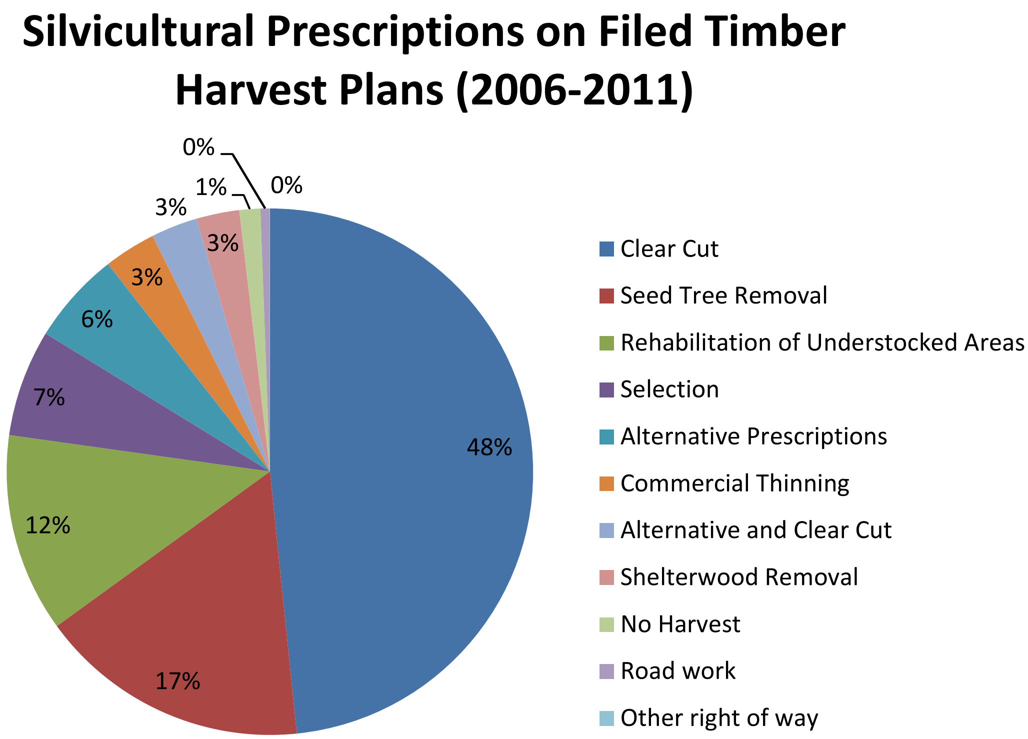
To meet this requirement we have provided evidence of numerous planned harvests by a private, for-profit commercial forest management entity on the project site. Between 2006 and 2011, 36 THPs were filed on the project site (Supplement N – Timber Harvest Plan Data) covering over 3,000 acres of land (Map 3).

Map 3: Timber Harvest Plans in the Project Site



The percentage of operations planned for these acres by total acreage is shown in Figure 1. While many of these Timber Harvest Plans were never implemented, it can be assumed that they demonstrate an example of financially viable operations that can form the basis of a modeled baseline scenario. The predominant management methods modeled within the baseline scenario are compatible with the operations described within the THPs filed over the past five years within the current project area.

Figure 1: Percentage of silviculture prescriptions by total acreage



iii. Estimate Baseline Onsite Carbon Stocks

REQUIRED: *Describe the processes and results from following the steps and requirements as described in Section 6.2.1 of the Forest Project Protocol v3.1. Based on the results of determining whether initial carbon stocks are above or below Common Practice (calculation of the Minimum Baseline Level or "MBL"), describe the process and the result of the analysis for determining the baseline carbon stocks over 100 years. Provide any relevant data and a chart displaying the tonnes of* CO_2e *present in the baseline. Include an explicit figure for the Project's baseline according to the Project's Modeling Plan.*

The following steps must be followed to estimate baseline carbon stocks (FPP v3.1 pp. 43):

- *Look up the Common Practice level of standing live carbon stocks for the Project's Assessment Area*

This project lies within the Southern Cascades Ecoregional Assessment Area. Using the CAR FPP Assessment Area Data File (Appendix F) document to look up the standing live carbon stock levels for areas of "high" and "low" Site Class, the values for above ground tCO2e/acre are the following:

- High Site Class – 128 tCO2e/acre
- Low Site Class – 86 tCO2e/acre

The estimator of area for "high" site class $\mathrm{a_H}$ is

$$\mathrm{a_H} = \frac{\mathrm{a_{REG}}}{\mathrm{n_{MPS}}} \sum_{\mathrm{i} \in \mathcal{P}_{\mathrm{MPS}}} \mathrm{y_{SC\,i}} + \frac{\mathrm{a_{PC}}}{\mathrm{n_{PCS}}} \sum_{\mathrm{k} \in \mathcal{P}_{\mathrm{PCS}}} \mathrm{z_{SC\,k}}$$

where $\mathrm{n_{PCS}}$ is the number of plots in the Pre-Cruise area on which a site tree was measured, $\mathcal{P}_{\mathrm{PCS}}$ is an index set to plots in the Pre-Cruise area on which a site tree was measured, $\mathrm{n_{MPS}}$ is the number of measurement plots in the Cruise area on which a site tree was measured, $\mathcal{P}_{\mathrm{PCS}}$ is an index set to measurement plots in the Cruise area on which a site tree was measured, $\mathrm{y_{SC\,i}}$ is equal to one if the measured site tree in the Cruise area indicated "high" site class and $\mathrm{z_{SC\,k}}$ is equal to one if the measured site tree in the Pre-Cruise area indicated "high" site class.

The estimator of area for "low" site class $\mathrm{a_L}$ is $\mathrm{a_L} = \mathrm{a_{REG}} + \mathrm{a_{PC}} - \mathrm{a_H}$.

Pursuant to section 6.2.1 of the Forest Project Protocol 3.1 and guidance provided by CAR (see Appendix K), the weighted average of site class is needed to determine common practice carbon stocks. To determine the weighted average, the area of "high" and "low site" class must be estimated.

Under the California Forest Practice Rules, section 1060, Article 4, site classes are defined for tree species in major stand types. This classification system was used to determine "high" and "low" site classes for measured site trees on measurement plots in the Cruise and area and some plots in the Pre-Cruise area. Trees with classes I or II were categorized as "high" while trees with other classes were categorized as "low." Appendix L provides calculations of site class and estimates of area by site class based on CalFire-approved site index curves.

Estimates of area by site class are provided in Table 7. These estimates are for the forested area in the Project Area.

Table 7: Determining Weighted Average Common Practice tCO2e/acre

Ecoregional Assessment Area (Southern Cascades)			
Site Class	**CAR Assessment Area Value**	**Weight**	**Acreage**
High	128	51.50%	10,495.59
Low	86	48.50%	9,882.52
WEIGHTED AVG	107.63		20,378.11

- *Determine if the Project Area's initial standing live carbon stocks are above or below the Common Practice*

We have calculated the initial live above ground carbon stocks (tCO2e) to be 168.17 tCO2e/acre (see Supplement E – EP Inventory Report v2.10, Carbon Stock Estimates), which is above the calculated Common Practice value of 108 tCO2e/acre.

- *Estimate baseline carbon stocks, taking into account financial and legal constraints on harvesting in the Project Area. In addition since live carbon stocks are above Common Practice, the baseline for standing live carbon stocks must not fall below Common Practice.*

Model Calibration

The selected model used to develop this project is the Forest Project System version 7.0.3 (FPS) developed and maintained by the Forest Biometric Research Institute (FBRI).

The model was parameterized with silvicultural prescriptions and local calibration. It was parameterized to consider the required legal constraints of the California Forest Practice Rules FPRs) and Special Assessment Areas in the baseline scenario and in the project scenario the same, plus management plan objectives. The model was calibrated using inventory taper date obtained from the Western Timber Services cruise in 2008. These data served to calibrate the volume equations used to estimate yield.

Merchantability was specified for all Group A species as a minimum diameter of 6 inches and minimum log length of 16 feet. In reality, merchantability specifications would change over time as milling systems and markets evolve. The model does not assume how merchantability specifications would have change over the modeling period and thus these specifications were fixed throughout the modeling period. The Northern California Region 16 library was selected based on recommendation from FBRI. The project resides in this region generally defined by FBRI.

To assign site index to uncruised stands, we attempted to a fit a predictive statistical model, considering elevation, aspect, size class, stocking, and species composition as potential explanatory variables. However, exploratory data analysis and an attempted stepwise regression approach centered around AIC provided no statistically significant relationships between potential explanatory variables and calculated site indices. Site index was assigned to stands therefore by using simple aggregation by leading species. The mean site index as calculated by FPS within each Stand Type as defined by leading species (i.e. Redwood, Douglas Fir, Mixed Conifer, Mixed Pine, Hardwood, and Alder) was tabulated and assigned to all uncruised stands within that type. Site Indices as calculated by FPS were maintained for stands in which site index trees were measured. In non-cruised even aged stands for which no site quality information was available (i.e. types XXX and XXO), the site index was assumed to be equal to the average site index across all cruised stands. A factor of 1.44 was used to convert 50-year site index used by FPS to 100-year site index used by the FPR. The assigned site indices are shown in Table 8.

Table 8: Average Site Index by Species Strata

Type	Average SI
A (Alder)	75.45
C (Mixed Conifer)	83.78
D (Douglas Fir)	85.96
H (Hardwood)	89.89
P (Pine)	55.77
R (Redwood)*	85.96
X (Pre-merch)**	82.71

*Insufficient Redwood leading stands were cruised to estimate a mean site index, so SI was assumed to be the same as for Douglas Fir leading stands.
**Pre-merch stands were assumed to have a site index equal to the mean of all site indices on cruised stands.

Per FPS guidelines, individual tree data from cruised modeling units were expanded to other modeling units by vegetation stratum. For vegetation strata that did not contain any cruised modeling units, data were expanded from similar vegetation stratum with respect to expected species composition, density and size class. FPS uses a non-parametric method for expansion.

Model Implementation
The FPS model was implemented by first stratifying the project area by vegetation type, constructing logical modeling units, assigning constraints to modeling units, initializing the inventory and running the model for the baseline and project scenarios.

The Western Timber Services (WTS) inventory data from 216 plots located in the project area were used in the baseline and project model. Of the total 8,191 tree records in the WTS data, 115 were omitted from the model because they were obtained on plots outside the project area. The WTS cruise design met FPS requirements and therefore the data were easily imported the model.

The process to import the WTS data included both GIS and FPS exercises. A shapefile of the approximate locations of WTS plots was first clipped to the project area and then a spatial join was performed to attribute stand ID (modeling unit ID) to each point. Of the total 8,191 tree records in the WTS data, 115 were omitted from the model because they were obtained on plots outside the project area. Because the modeling units didn't necessarily line up with the Project Area boundaries, a minor number of points (161 tree records) were not assigned modeling unit IDs. A total of 527 plots were used by FPS to initialize the model.

After the plot data were imported into FPS, they were compiled by FPS and grown to 2011. After the plots were grown, they were expanded by FPS to uncruised stands. Vegetation strata with "XXX" or "XXO" labels were not cruised, so artificial plots were inserted into FPS for modeling units in these strata and then these modeling units were additionally compiled by FPS. These artificial plots reflected Douglas-fir planted at 300 trees per acre in year 2010. The origin year for all other modeling units was set to 1950 such that as of the project start date, the average age of stands was about 60 years. The average age of all stands was determined to be 63 years from the carbon inventory data.

The model was run by first growing all modeling units without implementing any silviculture over the entire modeling period of 100 years. Two copies of the FPS database were created, one for the baseline scenario and the other for the project scenario. Then, silvicultural regimes were specified for each of the modeling units in each database depending on timber site class, species composition and identified constraints. Each database was grown separately with the specified silviculture by modeling unit. Subsequently each modeling unit in each database contained growth records associated with no management and management, in some cases for some units these records were the same.

Second rotation yield tables were initialized for the CLR and PLT prescriptions and then grown over the entire modeling period of 100 years.

The final step was to schedule harvests within 10 year periods given period yield targets. The yield targets for the baseline scenario were determined by maximizing total yield over the 100 year modeling period which resulted in long-term sustained yield. The yield targets for the project scenario were determined by the management plan summary prepared by BBW and Associates. Harvest yields for the baseline are presented several ways in the following sections. Harvests were scheduled using the FPS Harvest Scheduler which employs linear programming to select modeling units for harvest over time. Stands with the targeted GROW prescription were excluded from harvest. The scheduler enforced adjacency constraints.

Carbon stocks were calculated using residual carbon stocks in modeling units for each scheduled period per the regression in Section 5.7 of the EP Modeling Report. These results are presented in Sections 6.1 and 6.2 of that same report.

Modeling results of residual growth and yield from the Harvest Scheduler were reviewed by exporting records to Excel workbooks (see Appendices D and E in the EP Modeling Report). Average growth records by year were examined by basal area, trees per acre and quadratic mean diameter. Growth records for the GROW regime in the baseline model are presented in Tables 9, 10 and 11. In addition to ecoPartners review, the growth presented in these tables was also reviewed by two other biometricians.

The outputs by modeling unit were examined in Appendix D using conditional formatting. During one model iteration, it was noted that growth estimates for stands “XXX” and “XXO” were lower than expected. It was identified that the origin year for those stands was incorrectly set and these records were revised with an origin year 2010. Growth in these stands was corrected as a result.

Growth in stands with low stocking was correct by the FBRI release of FPS 7.0.3. However, in-growth to these stands appears marginal over time (<1 tree/ac/yr). Many of these stands with low stocking (11 modeling units with <106 trees/ac) are scheduled for harvest and replanted within the first three periods. It is not expected that manually forcing in-growth (if possible in FPS) would change the baseline carbon stocks.

Table 9: Average basal area (sq ft/ac) by vegetation stratum and year for modeling units with GROW in the baseline model.

Vegetation Stratum	2015	2025	2035	2045	2055	2065	2075	2085	2095	2105
A22	94	109	120	134	156	170	181	192	198	204
A32	203	178	197	217	238	255	261	263	268	276
C22	105	119	130	136	152	169	186	193	201	207
C23	260	273	184	196	213	235	254	261	266	265
C31	123	143	166	162	176	194	211	225	232	238
C32	165	171	185	201	224	236	244	248	251	256
C33	185	105	120	137	165	200	213	221	226	229
C41	102	109	146	178	1	6	18	41	80	92
C42	183	148	120	137	148	152	170	184	192	179
D22	147	149	165	188	197	198	192	198	203	183
D23	162	216	204	209	201	204	211	217	214	219
D31	237	201	199	214	240	260	263	266	275	281
D32	157	169	188	211	224	229	225	234	240	224
D33	170	166	129	137	155	169	179	173	172	181
D41	249	302	279	272	288	311	319	326	328	328
D42	133	149	175	200	215	227	234	240	247	245
D43	0	6	26	68	80	86	72	81	93	60
H22	292	233	236	242	260	280	287	287	282	283
H23	262	259	197	212	231	255	274	276	274	271
H31	80	117	153	182	178	186	205	226	240	249
H32	175	175	189	216	245	257	264	265	267	262
H33	289	186	200	217	242	271	274	273	269	272
P23	82	82	81	62	50	59	68	79	92	108
P31	87	102	111	123	122	137	153	170	185	199
P32	98	105	119	127	110	124	138	152	166	183
R22	247	258	269	274	280	285	285	284	284	282
R31	242	269	298	318	337	356	367	377	387	391
R32	245	261	280	292	304	315	319	323	327	328
R41	246	296	325	353	367	381	394	396	398	400
XXO	1	7	24	51	86	122	150	173	187	208
XXX	1	7	24	51	86	123	148	169	187	205

Table 10: Average stocking (trees/ac) by vegetation stratum and year for modeling units with GROW in the baseline model.

Vegetation Stratum	*2015*	*2025*	*2035*	*2045*	*2055*	*2065*	*2075*	*2085*	*2095*	*2105*
A22	404	394	362	359	359	344	328	311	298	287
A32	681	569	594	576	566	540	505	480	464	454
C22	442	379	363	334	353	341	326	309	295	279
C23	990	848	499	588	572	560	540	494	464	439
C31	597	534	516	441	489	474	462	447	415	395
C32	460	507	485	472	462	427	405	385	368	357
C33	663	289	405	385	390	382	335	302	285	266
C41	544	376	440	430	70	277	263	259	258	196
C42	659	427	394	437	397	356	340	307	279	232
D22	535	589	561	546	483	446	418	404	391	368
D23	953	893	681	667	579	556	514	482	444	423
D31	734	534	519	516	510	471	430	411	399	387
D32	457	527	497	485	434	401	377	366	355	335
D33	457	370	282	334	326	295	262	224	210	204
D41	926	861	688	647	654	639	589	569	548	528
D42	665	618	588	557	530	505	486	471	459	443
D43	0	278	268	266	151	108	68	60	59	38
H22	975	669	689	646	636	616	575	545	517	499
H23	997	791	550	612	587	567	542	497	467	443
H31	665	594	552	527	424	423	428	413	396	375
H32	661	606	582	571	552	516	483	456	437	416
H33	876	502	595	579	564	548	498	469	443	430
P23	755	608	509	417	392	418	407	399	394	388
P31	750	719	623	592	531	556	548	536	518	506
P32	448	369	355	339	283	366	359	351	339	334
R22	903	846	788	764	741	718	696	673	651	630
R31	744	711	677	660	645	630	616	602	587	573
R32	715	674	636	620	603	587	571	555	538	522
R41	931	870	842	815	796	777	758	739	719	700
XXO	293	275	272	268	261	254	244	244	238	245
XXX	293	275	271	268	261	255	239	243	244	241

Table 11: Average QDBH (inches) by vegetation stratum and year for modeling units with GROW in the baseline model.

Vegetation Stratum	*2015*	*2025*	*2035*	*2045*	*2055*	*2065*	*2075*	*2085*	*2095*	*2105*
A22	5.8	6.5	7.0	7.6	8.5	9.3	10.1	10.9	11.5	12.1
A32	6.3	5.6	6.6	7.5	8.4	9.3	10.1	10.9	11.6	12.0
C22	6.4	6.9	7.2	7.3	8.1	9.0	9.8	10.4	11.2	11.9
C23	7.0	7.1	4.8	5.8	6.8	8.0	9.1	10.2	11.1	11.9
C31	6.0	7.0	7.6	6.1	6.9	7.8	8.7	9.5	10.3	11.0
C32	5.8	6.4	7.3	8.2	9.2	10.1	10.9	11.6	12.3	12.7
C33	7.1	4.0	5.4	6.3	7.7	9.2	10.6	11.6	12.6	13.6
C41	5.9	5.5	6.6	7.5	0.5	2.0	3.5	5.3	7.3	9.3
C42	7.0	5.5	4.4	5.7	6.6	7.6	9.2	10.6	12.0	12.5
D22	4.2	5.1	6.4	7.7	9.1	10.3	11.2	12.0	12.7	12.7
D23	5.6	6.6	5.9	6.3	6.4	7.1	8.2	9.3	10.3	11.4
D31	7.6	6.3	6.5	7.4	8.6	10.0	10.9	11.8	12.6	13.2
D32	5.1	6.1	7.3	8.5	9.9	11.0	11.7	12.6	13.2	13.3
D33	8.2	7.7	6.2	7.1	8.3	9.5	11.1	12.0	12.9	14.0
D41	7.0	8.0	7.2	7.2	8.0	9.1	10.0	10.9	11.5	12.0
D42	5.4	6.0	7.0	8.0	8.8	9.6	10.1	10.6	11.1	11.3
D43	0.0	2.0	4.2	6.8	9.8	12.2	14.0	15.8	17.0	17.1
H22	7.2	5.9	6.5	7.2	8.2	9.2	10.2	10.9	11.5	11.9
H23	6.9	6.6	5.2	6.3	7.4	8.6	9.9	11.0	11.8	12.5
H31	4.6	5.8	6.7	7.5	7.2	7.6	8.8	9.9	10.9	11.7
H32	5.2	5.6	6.4	7.5	8.7	9.9	10.8	11.7	12.3	12.8
H33	7.7	4.9	6.0	7.1	8.4	9.7	10.8	11.7	12.3	12.8
P23	4.5	4.4	4.4	2.9	2.6	3.4	4.0	4.7	5.5	6.3
P31	4.2	4.8	5.4	5.8	5.3	5.8	6.5	7.2	7.9	8.5
P32	5.9	7.3	7.9	8.4	5.7	6.5	7.2	7.9	8.7	9.4
R22	7.1	7.5	7.9	8.1	8.3	8.5	8.7	8.8	8.9	9.1
R31	7.7	8.3	9.0	9.4	9.8	10.2	10.5	10.7	11.0	11.2
R32	7.9	8.4	9.0	9.3	9.6	9.9	10.1	10.3	10.5	10.7
R41	7.0	7.9	8.4	8.9	9.2	9.5	9.8	9.9	10.1	10.2
XXO	0.6	2.2	4.0	5.9	7.7	9.2	10.1	10.8	11.2	12.0
XXX	0.6	2.2	4.0	5.9	7.7	9.2	10.0	10.6	11.2	11.8

The FPS Harvest Scheduler selected modeling units for final harvest in a total of 366 acres in constraint classes WLPZ1 and WS in the baseline model. Upon conferring with FBRI, any second rotation prescription is automatically available for final harvest. Until a later release of FPS, this error cannot be rectified. Additionally within these 366 acres, less than 10 acres in total failed to plant via the FPS growth model. Upon conferring with FBRI, a conclusion could not be reached as to why this very small fraction was not planted.

It is ecoPartners' opinion that these errors are a non-material because the "XXX" and "XXO" vegetation strata originated from even-aged management during some past events, and so those areas are not likely constrained in reality and can be harvested. Additionally, the CLR and PLT regimes are applied to the total acreage of each modeling unit when in reality these units would lose some planting area over time due to skid trails and landings. The following legal and management plan constraints in Table 12 were considered when parameterizing the model and management prescriptions for each were applied as outlined in Table 13.

Table 12: Management Constraints

Constraint	Description
Stream Class 1	150 ft buffer around Class 1 waterways
Stream Class 2	100 ft buffer around Class 2 waterways
Stream Class 3	50 ft buffer around Class 3 waterways
Stream Class 4	100 ft buffer around Class 4 waterways
NDDB Species	Natural Diversity Database species subject to surveying and habitat and avoidance requirements
Federal List	Subset of NDDB species that are threatened and endangered under federal law; Pacific fisher is only listed species in project area
Wild and Scenic River	1/4 mile zone around Klamath River; clear-cutting not explicitly prohibited from Wild & Scenic Zone but is not included in the model or the baseline
Road	25 ft road buffer
Northern Spotted Owl Detections	No changes to nesting habitat within 500 ft; no changes to roosting habitat within 1,000 ft
Northern Spotted Owl Territories	500 acres of owl habitat must be maintained within 0.7 miles of NSO detections, and 1,336 acres within 1.3 miles
Salamander Detections	Salamander observations from landowner data
Pacific Fisher Detections	Pacific fisher observations from landowner data
Serpentine Woodland Objective	Areas of poor stocking due to infertile serpentine soils; may be excluded from project
Prairie Objective	Areas recommended for prairie restoration
Oak Savannah Objective	Areas recommended for oak savannah restoration
Clear Cut Adjacency	Forest Practice Rules for even-aged silviculture requiring at least 300 feet between harvested units
Stocking Standards	Minimum planting and residual basal area standards of Resource Conservation from the Forest Practice Rules
Restricted Zones	Spatial harvesting limits imposed by the above riparian and wildlife constraints

Table 13: Silvicultural Prescriptions applied to areas within Baseline and Project Modeling

Constraint	Constraint Class	Baseline Prescription	Project Prescription
Stream Class 1	WLPZ1	GROW	GROW
Stream Class 2	WLPZ2	SLRP	GROW
Stream Class 3	WLPZ3	SLRP	GROW

Constraint	**Constraint Class**	**Baseline Prescription**	**Project Prescription**
Stream Class 4	WLPZ4	GROW	GROW
NDDB Species	WS	GROW	GROW
Federal List	WS	GROW	GROW
Wild and Scenic River	WS	GROW	GROW
Road (not imported into the model)	RD	NONE	NONE
Northern Spotted Owl Detections	WS	GROW	GROW
Northern Spotted Owl Territories	WS	GROW	GROW
Salamander Detections	WS	GROW	GROW
Pacific Fisher Detections	WS	GROW	GROW
Serpentine Woodland Objective	WS	GROW	GROW
Prairie Objective	WS	GROW	GROW
Oak Savannah Objective	WS	GROW	GROW

The following silvicultural prescriptions are defined in Table 14. See Appendix A within Supplement M – Modeling Report for a map of silvicultural prescriptions in the project area. All CLR and PLT prescriptions allow for the removal of all trees according to the legal constraints described in this report, which may include all trees at final rotation.

The natural regeneration model in FPS follows a 1/100th acre grid across the simulation area. This simulation area is typically 0.25 acres but can go as high as 2.5 acres for each stand. A list of species was generated by tolerance in the HABSPP table, assembled using the habitat classification routine and the species on the ownership. In version 7 of the FPS software, this also includes non-tree vegetation habitat classes. At every trigger point (1 growth step or 20' of height growth) all of the 1/100th acre grids are evaluated. Since the model created a stem map internally it knows the level of competition at every point. Given the level of competition at each point, the regeneration model introduces species by tolerance as listed in the habitat classification. Sometimes the answer is no vegetation of any kind can be put in the space. Once the tree is there the small tree model takes over and the survival is dependent on the small tree silviculture defined in the stand regimes. The small tree model is calibrated to FBRI field data and uses two parameters from the SILVICS table, PctHt and PctSur, which were left as FPS defaults for the even and uneven-aged regimes.

The model assumes that natural regeneration is a function of species tolerance relative to levels of density-dependent competition. The model as also assumes that early height growth and survival are near the defaults values provided by FPS.

Table 14: Prescription descriptions

Prescription	Regime Description
NONE	Not modeled, assumes no carbon stocks (only road features).
GROW	No management. Assumes natural regeneration as predicted by the approved-FPS growth model.
SLRP	Selection cuts from 380 to 300 ft^2/ac. Harvested with uniform selection over diameter classes and species. Harvest intervals vary by site class from 60 to 100+ years. Assumes natural regeneration. No species preferences were specified in the model and thus FPS selected trees randomly for harvest.
PLT1	Planting Douglas fir at 300 trees/ac.
CLR1	Clear cut for Site Class I: intermediate thinning to 125 ft^2/ac, planting Douglas fir at 300 trees/ac. Thinned from below. Group A species favored including Douglas fir, ponderosa pine and white fir. Harvest intervals vary by site class from 12 to 100+ years.
CLR2	Clear cut for Site Class I: intermediate thinning to 100 ft^2/ac, planting Douglas fir at 300 trees/ac. Thinned from below. Group A species favored including Douglas fir, ponderosa pine and white fir. Harvest intervals vary by site class from 12 to 100+ years.
CLR3	Clear cut for Site Class I: intermediate thinning to 100 ft^2/ac, planting Douglas fir at 300 trees/ac. Thinned from below. Group A species favored including Douglas fir, ponderosa pine and white fir. Harvest intervals vary by site class from 12 to 100+ years.
CLR4	Clear cut for Site Class I: intermediate thinning to 75 ft^2/ac, planting Douglas fir at 300 trees/ac. Thinned from below. Group A species favored including Douglas fir, ponderosa pine and white fir. Harvest intervals vary by site class from 12 to 100+ years.
CLR5	Clear cut for Site Class I: intermediate thinning to 50 ft^2/ac, planting Douglas fir at 300 trees/ac. Thinned from below. Group A species favored including Douglas fir, ponderosa pine and white fir. Harvest intervals vary by site class from 12 to 100+ years.
SLI1	Individual selection cuts from 200 to 125 ft^2/ac. Harvested with uniform selection over diameter classes and species. Harvest intervals vary by site class from 60 to 100+ years. Assumes natural regeneration as predicted by the approved-FPS growth model. No species preferences were specified in the model and thus FPS selected trees randomly for harvest.
SLL1	Light individual selection cuts from 280 to 240 ft^2/ac. Harvested with uniform selection over diameter classes and species. Harvest intervals vary by site class from 60 to 100+ years. Assumes natural regeneration as predicted by the approved-FPS growth model. No species preferences were specified in the model and thus FPS selected trees randomly for harvest.
SLGP	Group selection cuts from 200 to 125 ft^2/ac, less than 2.5 acre openings. Harvest intervals vary by site class from 60 to 100+ years. Assumes natural regeneration as predicted by the approved-FPS growth model. No species preferences were specified in the model and thus FPS selected trees randomly for harvest.

Carbon Project Modeled Values

Table 15 contains the Above Ground carbon stocks for the baseline scenario averaged over 100 years to be 113 tCO_2e/acre. This is not below the weighted average Common Practice value for the Project Area.

- Determine the baseline carbon stocks over 100 years for all required and optional carbon pools in the Project Area.

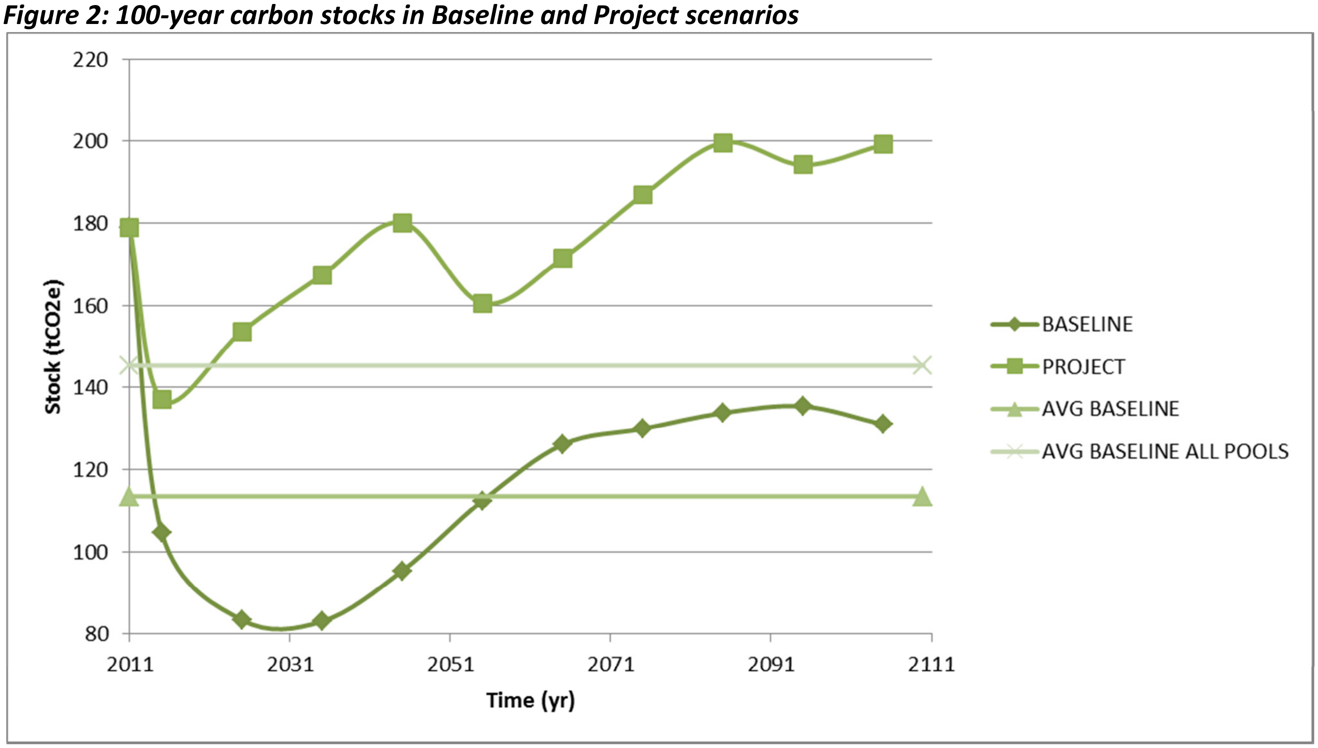
Table 15: Carbon stocks by end of scheduled period (baseline scenario)

Year	AG Stocks* (tCO2e/ac)	AG Stocks* (tCO2e)	AG, BG and SD+Stocks (tCO2e/ac)	AG, BG and SD+ Stocks* (tCO2e)
2015	105	2,174,509	134	2,792,893
2025	83	1,700,065	109	2,272,094
2035	83	1,692,948	109	2,263,580
2045	95	1,942,322	123	2,563,874
2055	112	2,290,445	144	2,990,075
2065	126	2,568,695	160	3,336,768
2075	130	2,646,823	165	3,435,096
2085	134	2,725,605	170	3,534,687
2095	135	2,758,336	172	3,576,195
2105	131	2,667,679	166	3,461,418
Average	**113**	**2,312,314**	**145**	**3,022,668**

*Adjusted for lot acreage
+Based on the regression function and below-ground biomass estimator identified in the Yurok Cruise Report

A graph demonstrating annualized project baseline carbon stocks, average baseline carbon stocks, and project carbon stocks over 100 years is demonstrated in Figure 2.

Figure 2: 100-year carbon stocks in Baseline and Project scenarios



Per FPS guidelines, individual tree data from cruised modeling units were expanded to other modeling units by vegetation stratum. For vegetation strata that did not contain any cruised modeling units, data were expanded from similar vegetation stratum with respect to expected species composition, density and size class. FPS uses a non-parametric method for expansion.

The project area was divided into the following strata:

- Non-forested areas including roads, streams, rock, water bodies, and grasses.
- Pre-Cruise area (those sampled prior to carbon inventory cruise as a timber cruise)
- Cruise area (sampled for carbon inventory)

Non-forested areas were derived from a land cover classification created by Western Timber and were verified using NAIP imagery. Active roads as interpreted in aerial imagery were buffered to 25 ft. The remaining area not designated as Pre-Cruise or non-forest was classified as the Cruise area. The Pre-Cruise area and the Cruise area are the sampling frame because these are the forested stratum. Table 16 is breakdown of strata by area and relative size.

Table 16: Inventory Areas

	Area (ac)	**% of Total**	**Sampling Frame**
Cruise Area	19,606.86	94.23%	Yes
Pre-Cruise Area	771.25	3.71%	Yes
Sub Total	20,378.11	97.93%	Yes
Non-Forested Area	429.85	2.07%	No
Total	**20,807.95**	**100.00%**	

The Pre-Cruise area was defined as a subset of the original WTS timber cruise prior to plot selection. Plots were not monumented in the WTS timber cruise which posed a verification risk, however the Yurok Tribe made a decision to minimize the cost of the new cruise inventory by retaining some of the WTS data in the Pre-Cruise area. The size of the Pre-Cruise area was targeted to be less than 5% of the project area to meet materiality thresholds specified by the Verification Program Manual. The boundaries of the pre-cruise area were arbitrarily selected in the GIS without regard to vegetation type or carbon stocks.

Those areas of the WTS timber cruise that were not included in the Pre-Cruise area were subject to sampling in the Cruise area. The delineation of the Pre-Cruise area was trivial because plot selection in the Cruise area was entirely subject to a probability model. Thus, all estimates were unbiased no matter how the Pre-Cruise area was defined.

Vegetation was stratified by Western Timber Services in 2008 as part of the timber valuation for land sale (see Appendix F). These strata were clipped to the Project Area and used for modeling purposes. Areas by vegetation stratum are given in Table 17 and were subdivided into modeling units.

Table 17: Strata Acreage

Vegetation Stratum	GIS Area (ac)*	FPS Area Net of Roads (ac)*
A22	527	499
A32	686	629
C22	561	523
C23	324	306
C31	461	418
C32	2,473	2,300
C33	174	163
C41	26	25
C42	79	75
D22	666	609
D23	361	337
D31	274	223
D32	3,509	3,291
D33	507	456
D41	23	23
D42	105	101
D43	18	18
H22	2,105	1,986
H23	324	306
H31	56	51
H32	3,613	3,401
H33	382	368
P23	29	28
P31	551	515
P32	149	144
R22	39	38
R31	52	51
R32	118	110
R41	156	154
XBR	268	252
XGR	3	1
XRB	23	22
XRK	1	1
XWB	6	6
XXO	251	209
XXX	1,608	1,413
Total	**20,506**	**19,430**

Table 18: Estimated carbon stocks in aboveground living and standing dead wood by stratum. *Adjusted by the ratio of lot acreage to GIS acreage.

	Average (tCO2e/ac)	Total (tCO2e)	Adjusted Total (tCO2e)*	% of Total
Cruise Area	218.14	4,276,984.89	4,365,891.94	95.73%
Pre-Cruise Area	247.29	190,720.53	194,685.10	4.27%
Non-Forested Areas	0	0	0	0.00%
Total	**219.24**	**4,467,705.43**	**4,560,577.05**	**100.00%**

Totals acreage for all carbon stocks are listed in Table 18 and are based on GIS area which is different than assessed lot area. The lot acreage is size of the project area. Estimated totals have been adjusted by the ratio of lot acreage to GIS acreage:

$$\frac{20{,}807.96}{21{,}240.50} \approx 1.020787319$$

The total stratified area within the project area is 20,506 acres which does not match the lot acreage of 21,240.5. Note that this total area is not equal to the Project Area lot acreage, Project area GIS acreage or the sum of the pre-cruise and cruise strata because the FPS model is based on the vegetation stratum defined in section 5.1. Average carbon stocks were estimated from all modeling units having a silvicultural regime other than NONE. This average was multiplied by the sum of the Cruise and Pre-Cruise Areas from the Cruise Report: 20,378.11 acres. Then to determine total carbon stocks the adjustment ratio of 1.020787319 was applied to determine total stocks relative to lot acreage (EP – Inventory Report v2.10).

The initial carbon stocks (AG living and SD) in the FPS model as of 2011 are 181.4 tCO2e/ac compared to 179.1 tCO2e/ac in the cruise report. Given the variance in the cruise report estimate, these values are not statistically different.

iv. Estimating Baseline Carbon in Harvested Wood Products (CAR FPP v3.1 Section 6.2.3)

REQUIRED: *Describe the process and results of determining the amount of carbon in harvested wood products according to the requirements as described in Section 6.2.3. Provide the final figures as well.*

Harvest yield has been provided from merchantable/non-merchantable species in the project scenario and baseline scenarios are summarized from the FPS harvest scheduler in Tables 19 & 20. An analysis of harvest yield by prescription, species, regime and year is given as Appendix F within Supplement M – EP Modeling Report.

Table 19: Baseline harvested wood volumes

Year	Net Yield (MBF)	Gross Yield (MBF)	Net Yield (ft^3)	Gross Yield (ft^3)
2015	131,023	151,369	27,937,335	32,175,362
2025	69,283	78,732	15,469,409	17,538,981
2035	41,632	46,506	8,951,643	9,994,933
2045	23,018	26,092	5,009,459	5,672,269
2055	14,644	16,185	3,157,584	3,489,664
2065	15,595	16,851	3,503,839	3,778,772

Year	Net Yield (MBF)	Gross Yield (MBF)	Net Yield (ft^3)	Gross Yield (ft^3)
2075	35,412	37,763	8,176,355	8,700,965
2085	22,865	24,315	5,433,970	5,771,669
2095	21,327	22,550	4,955,466	5,236,650
2105	20,146	21,397	4,591,992	4,871,750
Total	**394,946**	**441,758**	**87,187,051**	**97,231,015**

Table 20: Project harvested wood volumes

Year	Net Yield (MBF)	Gross Yield (MBF)	Net Yield (ft^3)	Gross Yield (ft^3)
2015	52,181	59,109	12,196,334	13,714,063
2025	3,281	3,687	746,275	833,198
2035	22,047	24,117	4,923,137	5,381,697
2045	4,820	5,364	1,072,980	1,188,616
2055	97,341	107,599	20,843,038	23,001,153
2065	160	169	42,335	44,564
2075	328	345	86,275	90,816
2085	4,701	4,948	1,217,850	1,281,947
2095	6,067	6,386	1,600,284	1,684,509
2105	295	310	75,527	79,502
Total	**191,220**	**212,035**	**42,804,034**	**47,300,065**

We have also calculated the total volume (ft^3) by species and specific species wood densities to properly calculate the total carbon in harvested wood volumes for merchantable and non-merchantable species. The totals are then used to calculate the amount of harvested wood that is stored for 100 years in wood products and landfills for each category of harvested timber (Table 21 & 22).

Table 21: Baseline harvest by species (merchantable and non-merchantable)

Species	ft^3 total	Wood Density*	lbsC/ft^3	Total lbs wood (Gross)
BM	1,527,104	0.44	27.456	41,928,167
CL	465,958	0.59	36.816	17,154,701
DF	45,921,372	0.46	28.704	1,318,127,048
GC	12,773,162	0.48	29.952	382,581,757
IC	677,917	0.35	21.84	14,805,706
JP	13,462	0.38	23.712	319,218
KP	194,097	0.37	23.088	4,481,306
OH	574,987	0.51	31.824	18,298,396
PC	2,430,774	0.39	24.336	59,155,310
PM	2,304,846	0.69	43.056	99,237,432
PP	1,491,768	0.38	23.712	35,372,797
RA	4,527,560	0.37	23.088	104,532,307
RC	7,891	0.31	19.344	152,648
RD	1,969,335	0.34	21.216	167,420

Species	ft^3 total	Wood Density*	lbsC/ft^3	Total lbs wood (Gross)
RO	14,136	0.41	25.584	50,383,470
RW	39	0.34	21.216	823
SP	1,814,911	0.34	21.216	299,909
TO	8,645,373	0.58	36.192	1,404
WF	2,023	0.37	23.088	41,902,676
WH	1,687,147	0.42	26.208	226,577,925
WP	143,191	0.35	21.84	44,179
TOTAL	87,187,051			2,415,523,775

*taken from Climate Action Reserve Biomass Equations document dated 3/15/11.

Table 22: Baseline harvest by species (merchantable)

Species	ft^3 total	Wood Density*	lbsC/ft^3	Total lbs wood (Net)
DF	45,921,372	0.46	28.704	1,318,127,048
IC	677,917	0.35	21.84	14,805,706
JP	13,462	0.38	23.712	319,218
KP	194,097	0.37	23.088	4,481,306
PC	2,430,774	0.39	24.336	59,155,310
PP	1,491,768	0.38	23.712	35,372,797
RC	7,891	0.31	19.344	152,648
RD	1,969,335	0.34	21.216	41,781,414
RO	14,136	0.41	25.584	361,655
RW	39	0.34	21.216	823
SP	1,814,911	0.34	21.216	38,505,162
WF	2,023	0.37	23.088	46,704
WH	1,687,147	0.42	26.208	44,216,736
WP	143,191	0.35	21.84	3,127,287
TOTAL	**56,368,062**			**1,560,453,812**

*taken from Climate Action Reserve Biomass Equations document dated 3/15/11.

Taking the total pounds of wood removed from the site over 100 years in the baseline scenario (Table 22), the amount delivered to mills, and the amount of wood that will leave the mill after processing was calculated (Table 23).

Table 23: Conversion of harvested wood carbon into tCO2e after milling

Harvested Wood Products in Baseline	Merchantable (Net)	Merchantable and Non-merchantable (Gross)
Total harvested wood weight (lbs/100 years)	1,560,453,812	2,415,523,775
Total harvested carbon (lbs/100 years)	780,226,906	1,207,761,888
Total harvested carbon (metric tonnes/100 years)	353,909	547,837
Total harvested tCO2e / 100 years	1,298,845	2,010,563
Total harvested tCO2e/year	12,988	20,106
Mill Efficiency (CA Softwoods*)	0.675	
Total annual tCO2e after milling	8,767	

*all merchantable harvested volumes are softwoods

After calculating the annual amount of material processed in mills, the categories of wood products that will be produced and the total tCO2e that will be stored in these products for 100 years was calculated in Table 24. The total percentages for each are taken from the default values provided in the CAR FPP v3.1 p. 95-96.

Table 24: Wood Products Categories and 100-year Storage

	Softwood Lumber	**Hardwood Lumber**	**Plywood**	**Oriented Strand Board**	**Non-structural Panels**	**Misc.**	**Paper**	**TOTAL**
Wood Product Distribution	69.50%	0.70%	27.70%	0.00%	0.10%	0.50%	1.50%	Rounded values
tCO2e	6,093	61	2,429	0	9	44	132	8,767
Annual % harvest In use (100 year storage)	46.30%	25.00%	48.40%	58.20%	38.00%	17.60%	5.80%	Rounded values
tCO2e	2,821	15	1,175	0	3	8	8	4,031

	Softwood Lumber	Hardwood Lumber	Plywood	Oriented Strand Board	Non-structural Panels	Misc.	Paper	TOTAL
Annual % harvest in Landfill (100 year storage)	29.80%	41.40%	28.70%	23.30%	34.40%	45.40%	17.80%	Rounded values
tCO2e	1,816	25	697	0	3	20	23	2,584

5. Project Carbon Stocks

a. Improved Forest Management (CAR FPP v3.1 Section 6.2)

i. Actual Onsite Carbon Stocks

REQUIRED: *Describe the process, as well as the results, used to update the Project Area's forest carbon inventory. Specifically, please describe the approved model being used to project prior-year data, ensuring that any sampling done in the previous year is incorporated in the modeling. Describe how the forest inventory estimate has accounted for any harvests and/or disturbances that occurred in the previous year. Also include a section describing how the confidence deduction for statistical uncertainty was derived, and show that it was applied appropriately to the forest inventory.*

Current inventory values were projected forward over 100 years in the baseline and project scenarios using the FPS version 7.0.

The model was parameterized with silvicultural prescriptions and local calibration. It was parameterized to consider the required legal constraints of the California Forest Practice Rules and Special Assessment Areas in the baseline scenario and in the project scenario the same, plus management plan objectives.

The model was calibrated using inventory taper date obtained from the Western Timber Services cruise in 2008. These data served to calibrate the volume equations used to estimate yield.

Merchantability was specified for all Group A species as a minimum diameter of 6 inches and minimum log length of 16 feet. In reality, merchantability specifications would change over time as milling systems and markets evolve. The model does not assume how merchantability specifications would have change over the modeling period and thus these specifications were fixed throughout the modeling period.

The Northern California Region 16 library was selected based on recommendation from FBRI. The project resides in this region generally defined by FBRI.

The estimated total carbon stocks in aboveground living, belowground living and standing dead wood is **4,560,577.05 tCO2e (219.24 tCO2e/ac)** and total carbon stocks in aboveground living and standing dead is **3,724,625.79 tCO2e (179.05 tCO2e/ac, 11.29% SEM at the 90% confidence level)**. These estimates are based on data collected in November and December of 2011 in the EP Inventory and data collected in the 2008 WTS Inventory. These estimates are for the forested area in the Project Area.

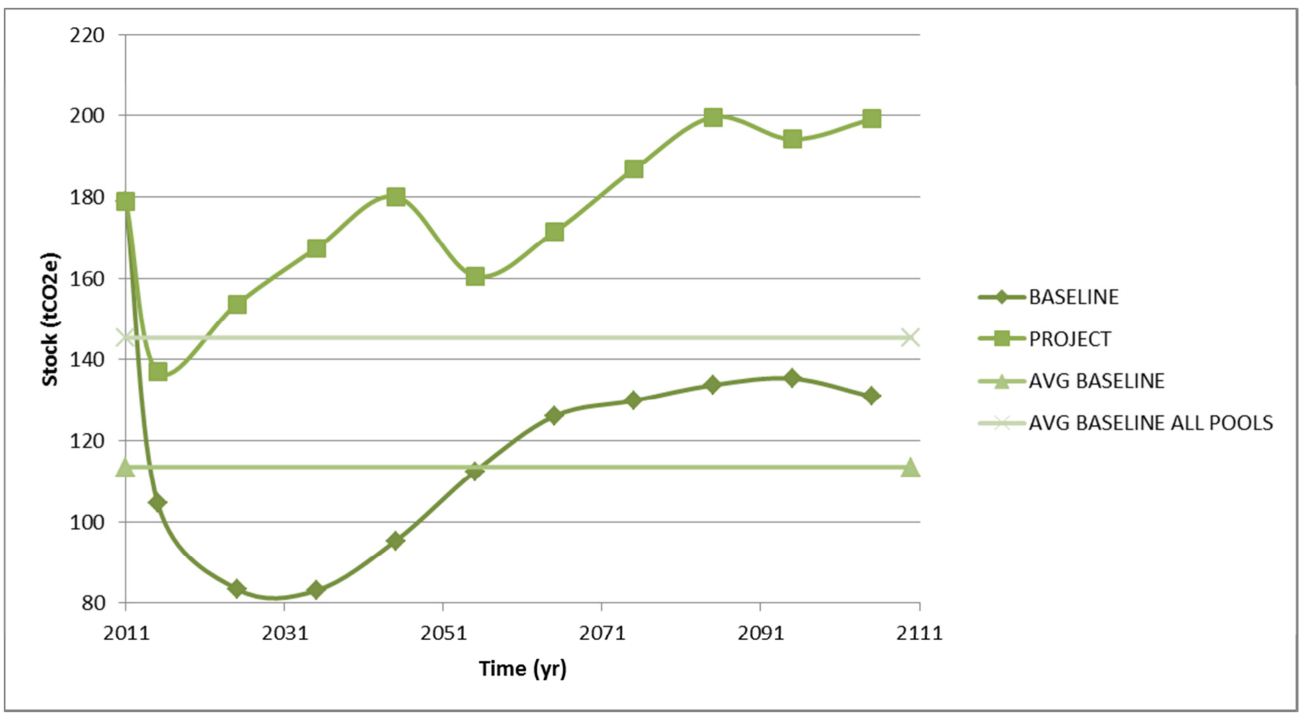
As demonstrated in Table 25, carbon stocks increase over time as reflected by periodic, low-intensity management.

Table 25: Project carbon stocks modeled over 100 years

Year	AG Stocks (tCO2e/ac)	AG Stocks* (tCO2e)	AG, BG and SD Stocks (tCO2e /ac)	AG, BG and SD Stocks* (tCO2e)
2015	137	2,849,475	174	3,618,263
2025	154	3,196,983	195	4,055,361
2035	167	3,482,030	212	4,420,199
2045	180	3,746,067	229	4,763,269
2055	161	3,339,231	204	4,236,713
2065	171	3,566,236	218	4,529,073
2075	187	3,885,833	238	4,946,880
2085	200	4,152,748	255	5,301,412
2095	194	4,039,939	248	5,150,948
2105	199	4,142,661	254	5,287,921
Average	**175**	**3,640,120**	**223**	**4,631,004**

Illustrated in Figure 3, average carbon stocks in above-ground trees for the baseline and project scenarios diverge over the 100 year modeling period.

Figure 3: 100-year carbon stocks in Baseline and Project scenarios



Initial baseline carbon stocks drop over the first three periods as a result of the expected management for timber revenue to fund the land acquisition. Such a drop would also be expected to even out age/size classes for long-term Maximum Sustained Yield. Baseline carbon stocks regrow over time in the baseline with periodic thinning. The project scenario reflects possible harvests scheduled in the management plan occurring periodically.

As calculated in Appendix J of Supplement E – EP Inventory Report, the estimated percent standard error of the mean is 11.3% at the 90% confidence level for aboveground living and standing dead wood. Figure 4 shows the bootstrap distribution of the estimated mean carbon stocks for the Cruise area. The R code used to implement the bootstrap is also in Appendix J and all other calculations of standard error are in Appendix I of Supplement E – EP Inventory Report. Total confidence deduction according to the CAR FPP v3.1 then equals:

11.3% - 5.1% = 6.2%

TOTAL CONFIDENCE DEDUCTION – 6.2%

ii. Actual Carbon in Harvested Wood Products

REQUIRED: *In this section, describe the process (and the result) used to determine the actual amount of carbon in standing live carbon stocks harvested in the current year. Further, determine the amount of harvested carbon that will remain in wood products averaged over 100 years, in accordance with the requirements described in Appendix A of CAR FPP v3.1.*

There have been no harvests of timber since the Project Start Date, so actual carbon stored in harvested wood products is zero.

iii. Quantifying Secondary Effects

REQUIRED: *In Improved Forest Management projects, emission from Secondary Effects can occur when a project reduces harvesting in the Project Area, resulting in an increase in harvesting on other properties controlled by the Forest Owner. In this section, describe the calculation of Equation 6.7, which quantifies the impact of this activity shifting.*

Equation 6.5 states that Secondary Effects are calculated as follows:

$$\mathrm{SE_y} = \min[0, (\mathrm{AC_{hv,y}} - \mathrm{BC_{hv,y}}) * 0.20]$$

With

$\mathrm{SE_y}$= Estimated annual Secondary Effects for year y
$\mathrm{AC_{hv,y}}$= Actual amount of onsite carbon harvested in year y prior to delivery to a mill
$\mathrm{BC_{hv,y}}$= Estimated average baseline amount of onsite carbon harvested in year y (prior to mill delivery)

Using figures from the average annual baseline (Table 23) we can summarize the calculation for 2012:

$$\mathrm{SE_{2012}} = (0 - 20{,}106) * 0.2 = -4{,}021\ \mathrm{tCO2e}$$

6. Calculation of GHG Reductions and Removals

a. All Project Types

***REQUIRED:** According to Equation 6.1, and based on the information provided in Sections 4 and 5 of the Project Design Document, describe the methodology as well as the final result for determining the GHG Reductions and Removals. Provide the Forest Project Calculation Worksheet with all project data input.*

Equation 6.1 below is used to calculate carbon reductions and removals for 2011, the initial year of this project (all units in tCO2e):

$$QR_{2011} = \left[(\Delta AC_{onsite} - \Delta BC_{onsite}) + \left(AC_{wp,2011} - BC_{wp,2011}\right) * 80\% + SE_{2011}\right]$$

Where:

QR_{2011} = Quantified Greenhouse Gas reductions for 2011

ΔAC_{onsite} = Change in actual onsite carbon (tCO2e)from previous year

ΔBC_{onsite} = Change in baseline carbon (tCO2e)from previous year

$AC_{wp,2011}$ = Actual carbon (tCO2e)in wood products produced in 2011 stored for 100 years

$BC_{wp,2011}$
= Annual carbon (tCO2e)in baseline wood products produced in 2011 stored for 100 years

SE_{2011} = Secondary effect greenhouse gas emissions (tCO2e) caused by project activites in 2011

$$\Delta AC_{onsite} = \left(AC_{onsite,2011}\right)(1 - CD_{2011}) - (AC_{onsite,2010})(1 - CD_{2010})$$

$$\Delta BC_{onsite} = \left(BC_{onsite,2011}\right) - (BC_{onsite,2010})$$

Since this is the first year of the project, all values for year 2010 are considered 0. This leaves the following calculation for actual onsite carbon in year 0.

$$\Delta AC_{onsite} - \Delta BC_{onsite} = \left((4{,}560{,}577) * (1 - 0.062)\right) - 3{,}022{,}668 = 1{,}255{,}153 \text{ tCO2e}$$

As no actual wood products have been harvested since the project start date:

$$AC_{wp,2011} = 0$$

Taking the data from Table 24 of the PDD, we calculate the baseline wood products to be

$$BC_{wp.2011} = (\text{In Use Wood Products}) + (\text{Landfill Wood Products})$$

$$BC_{wp,2011} = (4{,}030) + (2{,}585)$$

So

$$\left(AC_{wp,2011} - BC_{wp,2011}\right) = -6{,}615 \text{ tCO2e}$$

Giving us a total for year 2011 of

$$QR_{2011} = (1{,}255{,}153) + [(-6{,}615) * 0.8] + (-4{,}021) = 1{,}245{,}840 \text{ tCO2e}$$

All of these calculations have been uploaded into Supplement L – Carbon Calculation Worksheet. This document was created using the most recent worksheet version available at the Climate Action Reserve web site.

7. Reversal Risk Rating

a. Reversal Risk Rating by Category

***REQUIRED:** Show the calculation of the project's reversal risk rating and contribution to the Buffer Pool per Appendix D of the CAR FP v3.1.*

The project reversal risk calculations for each risk category are presented in Table26.

Table 26: Reversal Risk Rating

Risk Category	Source	Risk Rating
Financial Failure	Default Risk for Tribal Ownership	1%
Illegal Forest Biomass Removal	Default Risk	0%
Conversion	Default Risk	2%
Over-harvesting	Default Risk	2%
Social	Default Risk	2%
Wildfire	Calculated Risk from worksheet	4%
Disease or Insect Outbreak	Calculated Risk from worksheet	3%
Other Catastrophic Events	Calculated Risk from worksheet	3%
PIA	Default Risk	0%

b. Project Reversal Risk Rating

***REQUIRED**: Show the calculation of the project's reversal risk rating and contribution to the Buffer Pool per Appendix D of CAR FPP v3.1.*

Since project lands are owned by the Tribal government, the total project risk calculation will use values identified in Table 26..

$$\text{Project Reversal Risk Rating} = 100\% - \big((1 - \text{Financial Failure\%}) * (1 - \text{IllegalBiomassRemoval\%}) * (1 - \text{Conversion\%}) * (1 - \text{OverHarvesting\%}) * (1 - \text{SocialRisk\%}) * (1 - \text{Wildfire\%}) * (1 - \text{DiseaseInsectOutbreak\%}) * (1 - \text{OtherCatastrophe\%}) * (1 - \text{PIA\%})\big)$$

$$\text{Project Reversal Risk Rating} = 100\% - (99\% * 100\% * 98\% * 98\% * 98\% * 96\% * 97\% * 97\% * 100\%)$$

$$\text{Project Reversal Risk Rating} = 100\% - 84.2\% = 15.8\%$$

TOTAL QUANTIFIED GREENHOUSE GAS REDUCTION = 1,245,840 tCO2e

BUFFER POOL CONTRIBUTION = 196,843 tCO2e

TOTAL CRT (2011) = 1,048,997 tCO2e

8. Certified Forester Attestation

All project design documents have been submitted under the supervision of a California Registered Professional Forester per the requirements of Forest Project Protocol v 3.1 section 9 Reporting Requirements.

James Erler

Name

[signature]

Signature

RPF 2323

Certification Number