RBS 2019

IFM Offset Project Data Report

(CAR1381 / CAFR6381)

California EPA Air Resources Board
Compliance Offset Protocol – U.S. Forest Projects (IFM)
Adopted: 25 June 2015

Initial/Annual OPDR for Reporting Period:
15 Oct 2019 – 31 Mar 2021

OPDR Version 2.2

June 2nd, 2022

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1 – Introduction

The RBS 2019 Project is an Improved Forest Management (IFM) project developed pursuant to the California Air Resources Board Compliance Offset Protocol – U.S Forest Projects (herein noted as FOP) adopted June 25, 2015. The offset project operator is Sierra Pacific Industries (herein noted as SPI), which manages nearly 2 million acres of timberland in California and Washington, which all SPI lands are within the scope of certification under the Sustainable Forestry Initiative Certification Program. The approximately 83,886.26-acre project is located on commercial timberland held in fee ownership by SPI in Shasta County (42,569 acres; 51%), Butte County (28,365 acres; 34%), and Tehama County (12,952 acres; 15%) of California.

This version of the OPDR includes the required information as requested in attachments E, F, G, H, and K; therefore, these attachments are not provided separately. Documents meeting the requirements for attachments A, I, L, and shapefiles required in attachment E are included as separate attachments to this report. Attachments B, C, and D are not applicable to this project.

2 – Ownership Interest and Offset Project Operator

SPI is the sole owner of the land and is identified as the Offset Project Operator with the legal authority to implement the offset project (Table 1). Third parties do exist that may have existing property interest (mineral rights, easements, right of way, leases, etc.) in the project area (refer to RBS 2019 other entities.xlsx). These parties are gathered from the title documents and compiled in the "other entities" spreadsheet. If the date of the property interest to an individual is 50 years or older, it is assumed that the individual is deceased, and the address is noted as "N/A". For dates newer than this, a search is done using ParcelQuest software (https://parcelquest.com) for the entity named in the document. In addition, all companies and corporations are searched for in Google in an attempt to secure an address; if none is found, the entity is assumed to no longer be in existence. These third parties, however, have no ownership of the timber that would affect carbon in the project area, as that solely belongs to SPI.

The information reported in Table 1 below is the contact information for the person submitting the project and technical consultants were also used in the preparation of the offset project and the OPDR (Table 2). Adam Taylor (AHTaylor@spi-ind.com), Inventory Forester, of Sierra Pacific Industries also aids in the upload and submission of project information (contact information including phone number, mailing address, and physical address found in Table 1 would be the same for Adam Taylor).

Table 1: Offset Project & OPO Information

Offset Project Name & Project ID:	RBS 2019 (CAR1381)
ARB Project ID:	CAFR6381
Latitude (NAD 27 Zone 10)	40.4507255
Longitude (NAD 27 Zone 10)	-121.701955
Offset Project Commencement Date:	15 Oct 2019
First Reporting Period Start Date:	15 Oct 2019
First Reporting Period End Date:	31 Mar 2021
OPO Contact Person & CITSS #:	Edward Murphy (CA 1555)
OPO Name and Mailing Address	Sierra Pacific Industries (Attn: Edward Murphy) PO Box 496014 Redding, CA 96049-6014
Physical Address	19794 Riverside Ave Anderson, CA 96007
OPO Email Address	emurphy@spi-ind.com
OPO Phone Number:	530-378-8131

There is no Authorized Project Designee (APD) for this project. This report is being submitted for a verification period, which is also the initial reporting period for an Improved Management Project.

Table 2: Technical Consultants

Company Name	Alpine Land Information Services
Company Contacts	Justin Barrett Russ Bryant
Physical and Mailing Address	4451 Caterpillar Rd STE 6 Redding, CA 96003
Email Address	jbarrett@alpine-lis.com rbryant@alpine-lis.com
Phone Number:	530-222-8100

3 – Project Eligibility

a) Project Type

The RBS 2019 Project is an Improved Forest Management project located on private lands as defined by the FOP. The project will produce CO2e emission reductions by managing the forest lands to increase carbon sequestration and stocking when compared to project baseline. The forest owner declares:

1. The project takes place on forestland that has greater than 10% tree canopy cover (Appendix A).
2. The forest project and associated project lands have met and been in compliance with all local, state, or federal regulatory requirements during the reporting period.
3. The project has not and does not employ broadcast fertilization.
4. The project does not and will not employ a qualified conservation easement.
5. No GHG emission reductions within the project area were sold to any third party prior to listing.
6. The project employs natural forest management practices as defined in Section 3 of the FOP.
7. The project site has no physical address; any mail should be sent to the mailing address in Table 1.

b) Project Location and Project Area

The 83,886.26 acres in this forest project are within multiple Township, Ranges, and Sections in Butte, Shasta, and Tehama counties of California (Figure 1). The project area elevation ascends from 2,000 ft to roughly 6,600 ft along the southern end of the Southern Cascades range and Sierra Nevadas, and various streams and rivers flow through the project area. Various logging roads maintained by SPI are in the area, with State HWY 299 splitting the northern sections of the project area and State HWY 32 splitting the sections in the south. Surrounding towns include Big Bend and Round Mountain in the north, and Cohasset and Butte Meadows in the south.

The project area also falls within/borders 42 planning watersheds; however, much of the area falls within Indian Creek (5526.150102, 12%), Campbell Creek (5509.140102, 12%), Carpenter Ridge (5521.300202, 12%), Dry Burney Creek (5526.330102, 9%), Bull Creek (5521.300205, 9%), Timbered Crater (5521.300201, 9%), and Ninemile Creek (5509.140101, 7%) (Figure 3).

There are no significant development pressures applicable to the project area and the land is zoned as Timber Production Zone (TPZ) under California law. SPI included all commercial forest lands, that can meet the permanence requirement protocol in this logical management unit within the state planning watersheds and road systems that access them. The acreage was determined from SPI's proprietary GIS software.

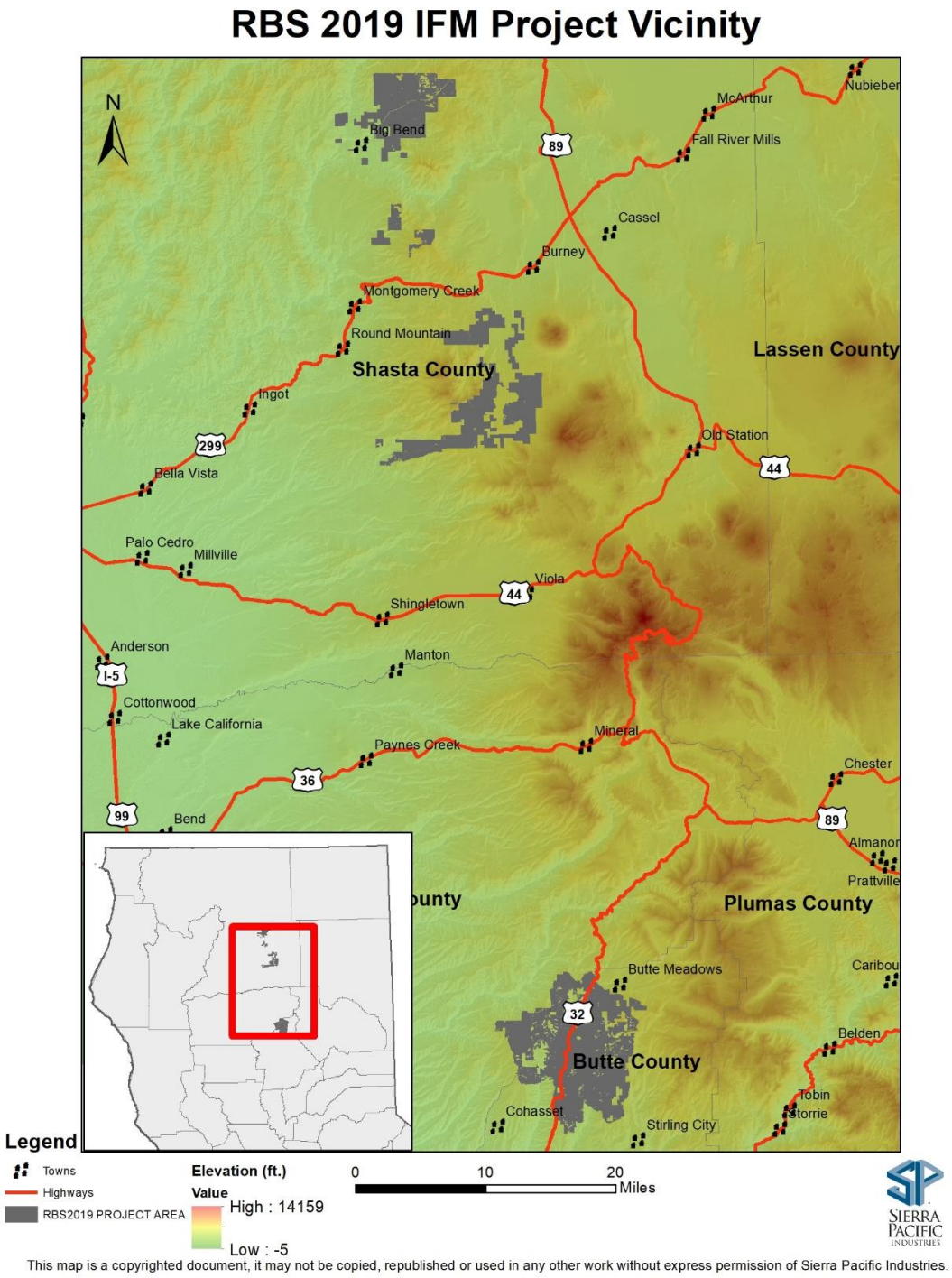


Figure 1 – Project Area Vicinity Map

Land Cover and Land Use: Historical, Present and Projected

Since the early 20th century various landowners have repeatedly harvested the lands presently owned by SPI. The majority of the RBS 2019 project area was acquired by SPI in 1992 from Roseburg Resource Company, Publishers in 1978, and Watt in 1973 and has since been harvested using predominately even aged silviculture.

Much of the surrounding land to the east and west are zoned as Public/Timber Mountain land in Tehama and Butte County and managed by the United States Forest Service (USFS) in Lassen National Forest. Prior to European colonization, the area was inhabited by indigenous people belonging to the Yana, Atsugewi, and Achumawi tribes. After colonization, these lands were predominately mined by early settlers before becoming a national forest in 1916. Presently, Lassen National Forest is predominately used for public recreation purposes. Lands not controlled by the USFS, are predominately lands managed for timber production. In addition, there are some small private landholdings adjacent to or near the project area zoned as Foothill/Rural Residential which are used for residential housing (Figure 2).

Projected land uses within the area include management and production of timber for eventual harvest and a 100-year commitment to the Improved Forest Management Project. Lands surrounding the project area are projected to be controlled and managed for recreation purposes by the USFS, and private residential housing for the foreseeable future.

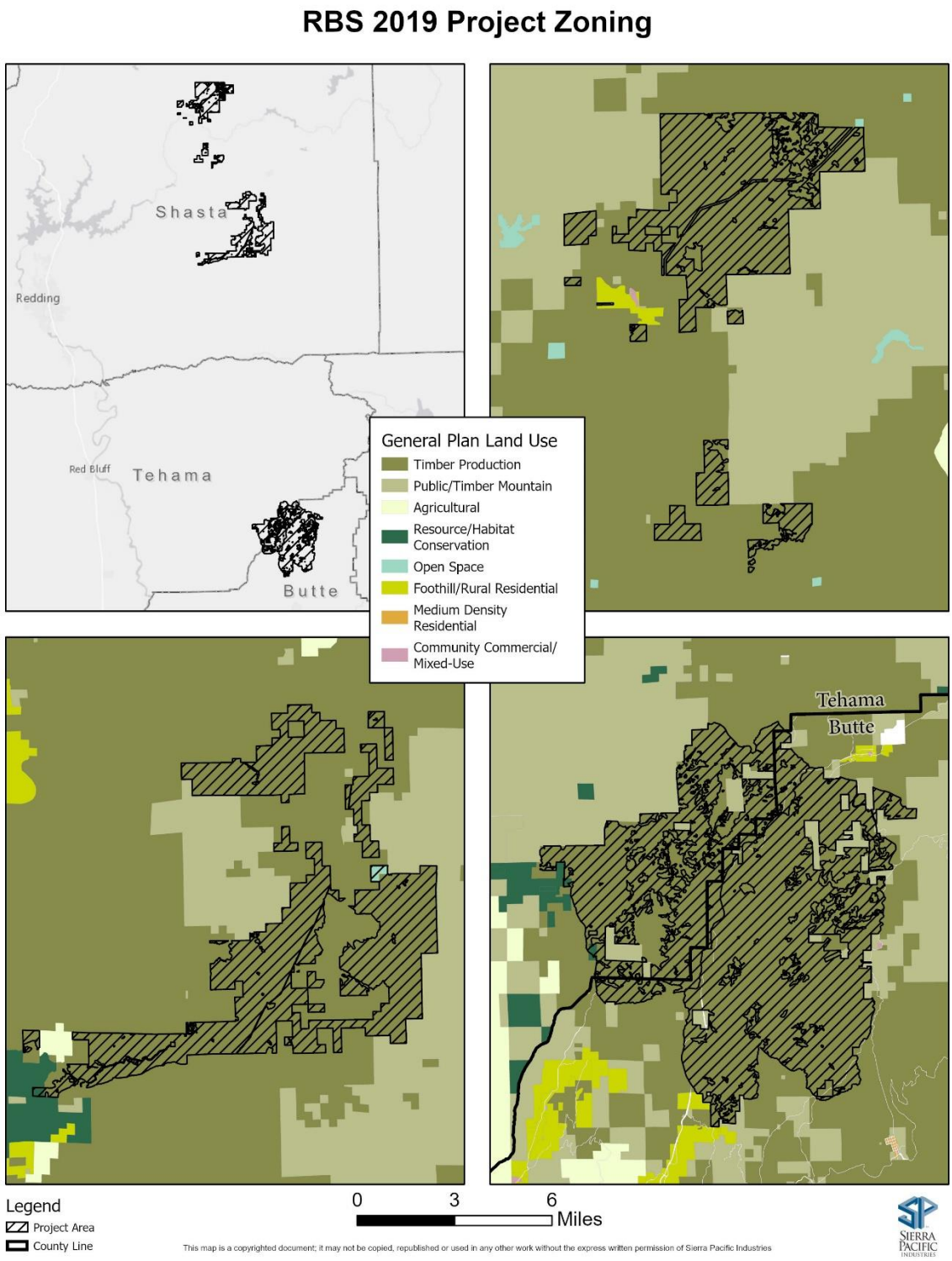


Figure 2 – Project Area and Surrounding Land Zoning Map

Forest Vegetation Types and Climate

The forest project is in a mountainous and forested landscape within the Cascade Biotic Province of Northern California. Dominant vegetation species include Douglas Fir, Ponderosa Pine, White Fir, Oak, and Incense Cedar. The climate is highlighted by dry & warm summers, and rainy winters with an annual average precipitation of 60 inches (Welsh Jr. 1994).

Known or Potential Diseases

Known or potential disease(s) and pest infestations potentially affecting tree health in the project's inventory include two root diseases and infestations from bark beetles. The root diseases include black-stain fungus (*Leptographium wageneri*) and annosus (*Heterobasidion annosum* or *Fomes annosus*) root disease.

Black-stain root disease is a vascular wilt occurring in several western North American conifers that infects roots and can move some distance up the base of the stem. The disease affects the water-conducting tissue of the host's root system, ultimately blocking water movement to foliage. Black-stain root disease is the only vascular wilt known among conifers and consists of a pathogen spread by insect vectors including bark beetles and weevils. The principal black-stain root disease hosts in the project area include Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), and Jeffrey pine (*Pinus jeffreyi*).

Annosus root disease is a fungal disease that can infect many conifers and some hardwood species. The disease occurs in temperate zones throughout the Northern Hemisphere and is common on conifers in the western United States. Infected trees suffer root and butt decay, and root mortality; resulting in reduced vigor, wind-throw, predisposition to bark beetles, and mortality. Primary hosts species in the project area include true firs (*Abies* spp.), pines (*Pinus* spp.), and Incense cedar (*Calocedrus decurrens*).

Bark beetles (family Scolytidae) are common pests of conifers in California. The most common beetle species occurring in conifer forest areas include engraver beetles, red turpentine beetle, western pine beetle, Jeffrey pine beetle, and mountain pine beetle. Bark beetles mine the inner bark on twigs, branches, or trunks of trees and shrubs, and can contribute to the decline and eventual death of trees. Primary bark beetle species in the project area include engraver beetles (Ips spp.), fir engraver (*Scolytus ventralis*), Jeffrey pine beetle (*Dendroctonus jeffreyi*), mountain pine beetle (*Dendroctonus ponderosae*), red turpentine beetle (*Dendroctonus valens*), and western pine beetle (*Dendroctonus brevicomis).*

SPI monitors for these diseases and outbreaks during routine forest management activities. No epidemic root disease or beetle infestations have been observed in the project area. These disease and beetle infestations occur at endemic levels in all forests and when combined with abiotic factors and high density are some of the agents of normal mortality supporting the dead and down carbon stocks in the project area.

Any Previous Status as an Offset Project

The RBS 2019 project was never listed as an early action offset project, therefore is not transitioning to the Compliance Offset Protocol U.S. Forest Projects. The project was previously listed as four separate projects (CAR1378 Ninemile 2019, CAR1379 Bull Creek, CAR1380 Big Bend 2019, and CAR1381 Dry Burney 2019) however these projects were merged into CAR1381, and the offset project was renamed to RBS 2019. Listing information was completed for submittal by Ed Murphy (RPF #2066) on 15-Oct-2019 and listed on 12-May-2021 on the Climate Action Reserves registry. Changes have occurred in the project since listing, therefore not all the information submitted for project listing is still accurate. Refer to Table 3 below for changes in the project since listing.

Table 3: Changes between Listing and OPDR

Item #	Item	Listing pg. #	OPDR pg. #	Revisions
1	Offset project name	2	1	The offset project name was updated to reflect the merger of all four offset projects.
2	Project area acres	2	1	The project area was adjusted to reflect more accurate GIS delineations of limited option and non-timber ground that was removed from the project area. The project area also increased because of merging four projects into one.
3	Species composition	3.(I)	6-7	Newly acquired inventory has resulted in an update to species composition.
4	Summary of carbon stocks	7.(C)	37-39	Onsite carbon stock estimates have changed due to new project area boundaries, and updated inventory.
5	Baseline carbon stocks	9.(A.2)	31-34	Baseline carbon stock estimates have changed because of updated inventory leveraged at project commencement and differences in baseline modeling.
6	Initial above ground standing live carbon stocks	9.(B.1)	31	Estimated initial above ground standing live carbon stocks have changed because of the updated inventory leveraged.
7	Extending the initial reporting period	2	2	The initial reporting period was extended from April 14th, 2020 to March 31st, 2021.

c) Additionality

i. Legal Requirements

This project is not being implemented and conducted as the result of any law, statute, regulation, or court order, or other legally binding mandate. The project only declares claims on baseline and forest project emission reductions and removals that reflect all legal constraints within the project area (Appendix B).

ii. Performance Standard Test

This project is an Improved Forest Management project and automatically satisfies the Performance standard Test.

d) Project Commencement Date

The project commencement date has been identified as 15-Oct-2019, denoted by the listing information. Justification of commencement date is the verifiable action based on SPI management decision to commit to an ARB compliant carbon project for a period of over 100 years and submit the offset project listing information for this forest project per section 3.6(a)(2)(A) in the FOP.

e) Sustainable Harvesting Practices

Commercial harvesting will be employed on the project area; therefore, it is necessary for the project to demonstrate sustainable long-term harvesting practices. SPI will demonstrate third party certification under the Sustainable Forestry Initiative, whose certification standards require adherence to and verification of harvest levels which can be permanently sustained over time.

f) Natural Forest Management

i. Native Species

The project consists of at least 95% of standing live native species assessed using the distribution of basal area per acre of listed native species (Table 4).

Table 4: Standing live basal area percentage by species.

SPI Species ID	ARB Species ID	Common Name	Scientific Name	BA/Acre Percentage
3	15	White Fir	*Abies concolor*	24.9%
1	202	Douglas Fir	*Pseudotsuga menziesii*	24.9%
8	81	Incense Cedar	*Calocedrus decurrens*	13.7%
9	122	Ponderosa Pine	*Pinus ponderosa*	12.8%
10	117	Sugar Pine	*Pinus lambertiana*	7.1%
27	818	Black Oak	*Quercus kelloggi*	6.5%
26	805	Live Oak	*Quercus chrysolepsis*	3.4%
21	631	Tanoak	*Notholithocarpus densiflorus*	3.2%

24	312	Big Leaf Maple	*Acer macrophyllum*	1.0%
13	20	Red Fir	*Abies magnifica*	0.8%
28	999	Other Hardwood *sp.*	-	0.7%
11	108	Lodgepole Pine	*Pinus contorta*	0.4%
20	351	Alder	*Alnus sp.*	0.3%
17	299	Other Conifer *sp.*	-	0.2%
15	231	Pacific Yew	*Taxus brevifolia*	0.1%
22	361	Pacific Madrone	*Arbutus menziesii*	< 0.1%
23	431	Golden Chinquapin	*Chrysolepis chrysophylla*	< 0.1%
46	212	Giant Sequoia	*Sequoiadendron giganteum*	< 0.1%
25	981	California Laurel	*Umbellularia californica*	< 0.1%
			Total	**100%**

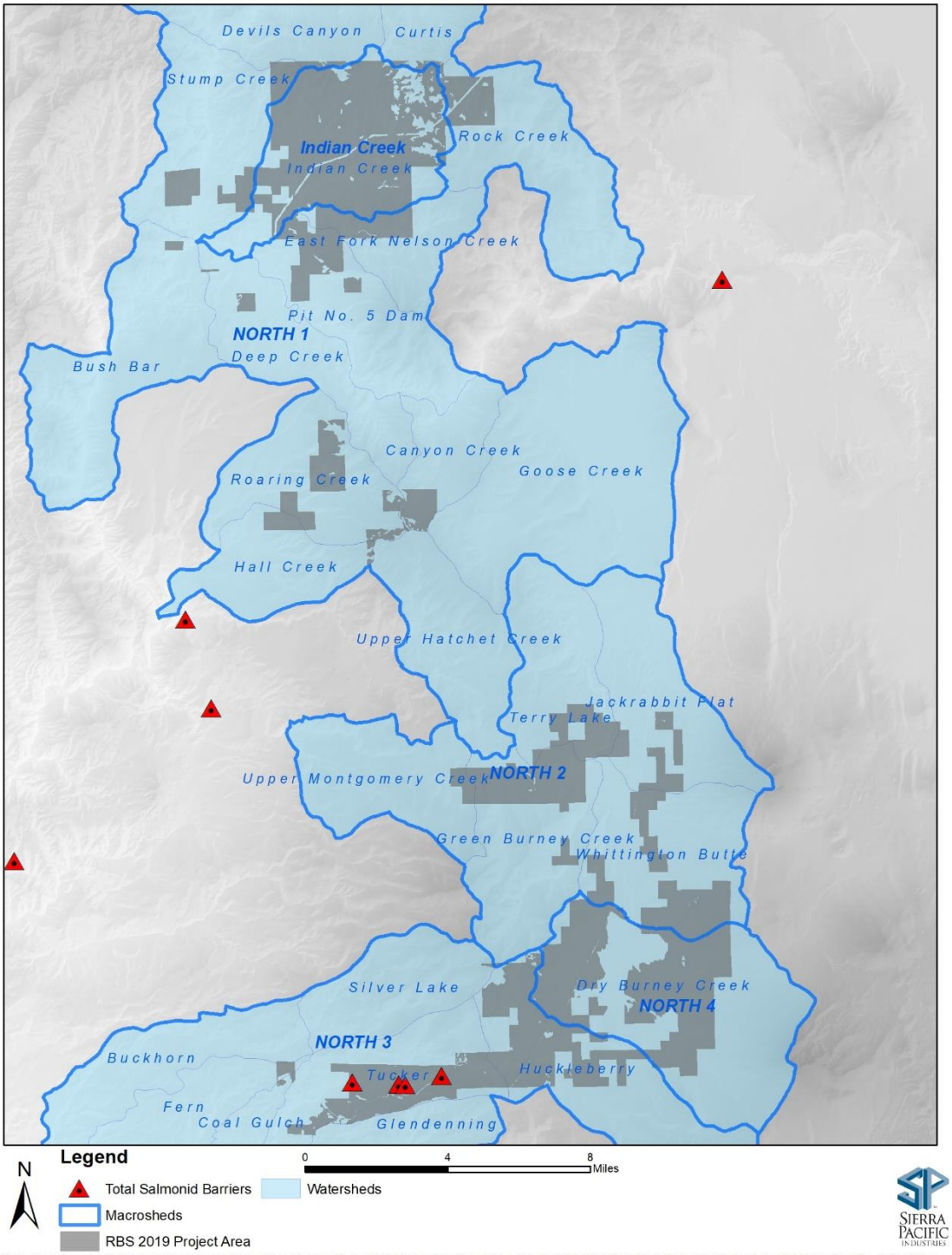
ii. Composition of Native Species

The FOP requires that no single species in the project area exceeds the given percentage value of standing live tree carbon shown under the heading "Species Diversity Index" in the Assessment Area Data File for the associated projects assessment area(s). Given that this project is in the Southern Cascades, no species can comprise of greater than 65% of the total basal area. As indicated in Table 4, no single species exceeds the 65% species diversity index (by basal area/acre) for the project area.

iii. Distribution of Age Classes

The project consists primarily of young growth, mixed-aged timber stands (approximately 79% of the area). Some even-aged stands (regeneration) exist and are diverse in age classes with all less than or equal to 45 years old at projects commencement date. Age class was determined for all even-aged stands in the project area and mixed stands were deemed "NA" as they are much older than 20 years. Given the project area straddles 42 watersheds, watersheds were merged when applicable to create 10 macrosheds containing 10,000 acres or less of the project area, except Indian Creek (Figure 3). All macrosheds and Indian Creek were below the 40% threshold, with an average of 21.4% belonging to age classes less than 20 years. Therefore, the RBS 2019 IFM project meets the criteria of the FOP that no more than 40% of the forested acres on a watershed scale of 10,000 acres are in age classes of less than 20 years (refer to "RBS 2019 Watershed Analysis.xlsx").

RBS 2019 (North) Watersheds



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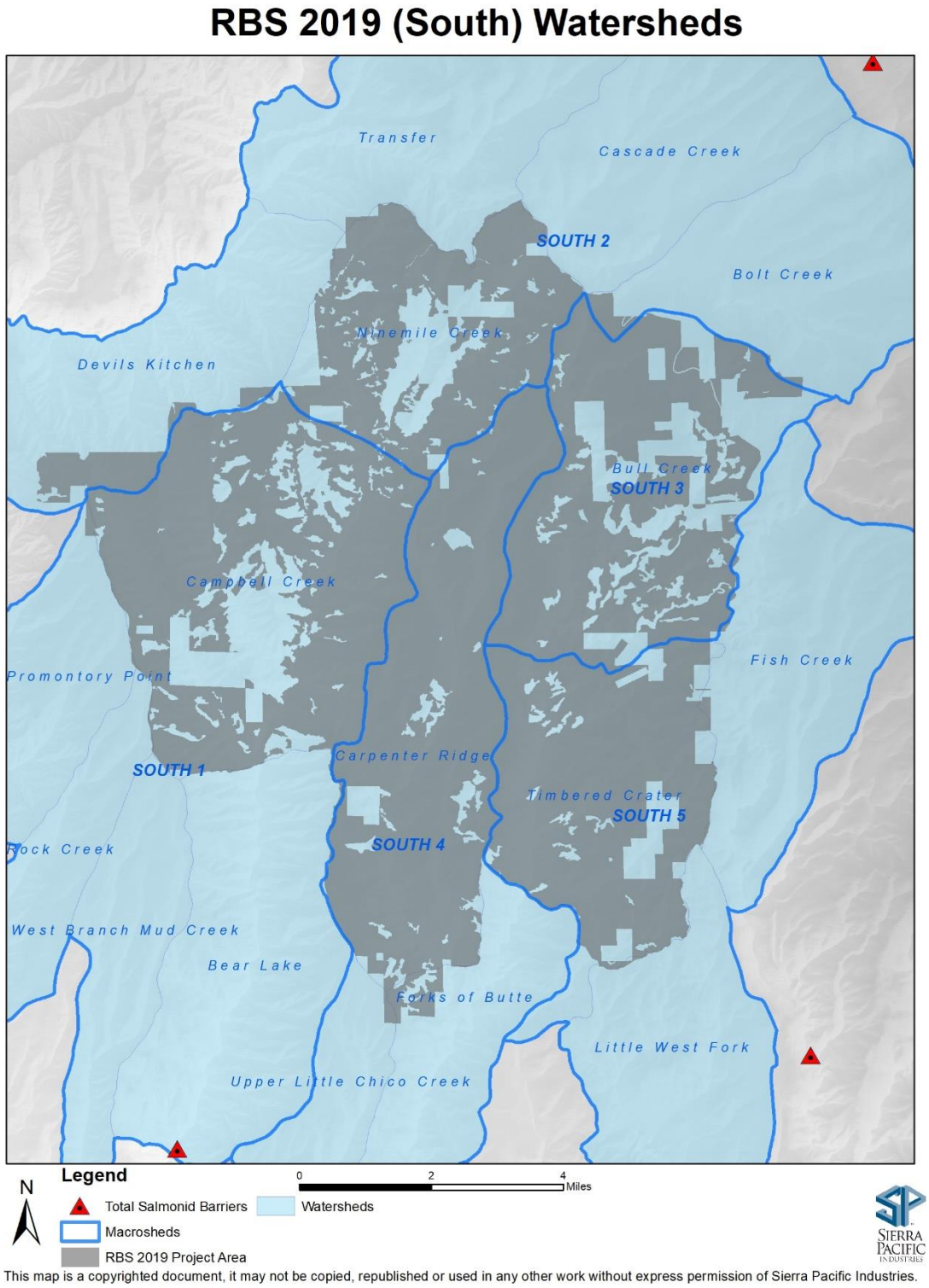


Figure 3 – RBS 2019 Watershed Map

iv. Structural Elements

Based on SPI's management policies and practices, the OPO believes the verifier will determine that the quantity of lying dead wood is commensurate with recruitment from standing dead trees (i.e., there is no evidence that lying dead wood has been actively removed). The project must maintain an average of at least:

Standard A: one (1) metric ton of carbon (C) in standing dead wood per acre;

Or

Standard B: 1% of standing live carbon stocks (above and below), in standing dead wood, whichever is higher.

The current standing dead wood stocks are 1.35 metric tonnes of carbon per acre (net; above and below), which is above Standard A. The current standing dead wood is 2.82% of the standing live carbon stocks, which exceeds Standard B. Therefore, the project meets both standards, and will continue to maintain (or demonstrate ongoing progress toward) either one of the above standards (Refer to "Confidential_RBS 2019_Calcs_Initial.xlsx – FP_NetAbvBelow_Live&Dead" sheet).

g) Ongoing Management Activities

Annual management activities in the form of commercial harvests and planting to return, and maintain optimum stocking creates a net increase in the rate of carbon sequestration. These actions/investments are matched by the annual management decision and investment in the form of holding otherwise merchantable timber to maintain this increased stocking of carbon on the project area when it is legally permissible to reduce that stock as evidenced by the baseline model. Sierra Pacific Industries management history includes even aged and un-even aged management. These management activities will continue during the project at a rate commensurable to the baseline model.

4 – Inventory Methodology

a) GHG Assessment Boundary

Table 5 was adapted from the Forest Offset Protocol Table 4.2 and describes the project's GHG assessment boundary. SSR #IFM-6 (soil carbon) was excluded in the analysis because no project activities triggered the analysis, therefore IFM-9 was not quantified as well.

Table 5: Sources, Sinks, and Reservoirs Included

SSR	Description	Type	Gas	Quantification Method
IFM-1	Standing live carbon (carbon in all portions of living trees)	Reservoir	CO_2	Baseline: Modeled based on initial inventory measurements. Project: Measured by field measurements and updating forest carbon inventory.
IFM-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir	CO_2	Baseline: Modeled based on initial inventory measurements. Project: Measured by field measurements and updating forest carbon inventory.
IFM-7	Carbon in in-use forest products	Reservoir	CO_2	Baseline: Baseline will be calculated from the modeled harvest volumes following the protocol methodology. The units are cubic foot volume to 6" Top for live-only trees greater or equal 10"DBH Project: This will be calculated from the actual cubic scale of annual harvested wood and following the protocol methodology.
IFM-8	Forest product carbon in landfills	Reservoir	CO_2	Baseline: Estimated from modeled harvest volumes. Project: Estimated from measured harvest volumes.
IFM-14	Biological emissions/removals from changes in harvesting on forestland outside the project area.	Source/Sink	CO_2	Baseline: N/A Project: Estimated using a default 20% "leakage" factor applied to the difference in harvest volume relative to baseline.
IFM-17	Biological emissions from decomposition of forest products	Source	CO_2	Baseline: Quantified as a component of calculating carbon stored for 100 years in wood products (IFM-7) and landfills (IFM-8). Project: Quantified as a component of calculating carbon stored for 100 years in wood products (IFM-7) and landfills (IFM-8).

b) Inventory Design and Sampling Process

i. Inventory Methodology for Mixed-Age Stands

The inventory methodology for mixed age stands followed a systematic 4 x 10 chain systematic grid. With this system, approximately one plot per four acres is allocated. Plots are organized in linear strips going north-south across sections. Variable radius plot sampling was conducted at each plot using a predetermined Basal Area Factor (BAF). The BAF for each plot is determined by using the pre-existing inventory basal area multiplied by 0.8 and divided by 4, with a maximum BAF of 50. After the primary cruise has been completed for all tally trees 8 inches DBH and above, an offset plot is created to attain trees less than an 8-inch DBH using the same BAF. The offset plot is randomly assigned at the time of cruise with a cardinal direction and distance between 10 and 20 feet from plot center. Detailed inventory methodology can be found in RBS 2019 Confidential Docs (Confidential_SPI_Appendix A(b) Requirements.docx)

Cruisers are supplied with a variety of standard equipment including: 12" increment borer, loggers' tape, Garmin GPS unit, Haglof® VL5 Hypsometer (includes a transponder and mount), Criterion® BAF Scope, plot center staff, and Apple® iPad mini with proprietary data collection software.

Note: A BAF of 50 was used for this project.

ii. Inventory Methodology for Plantations

Interim Plantation Surveys

Plantations (e.g., even-aged stands) aged 14 years and less are inventoried based on preliminary reconnaissance and sampling where unit conditions are observed and leveraged in identifying the representative sample area for each plantation's population. The population may range from being homogenous or diverse in tree and stand conditions, but the identified area would statistically represent the observed distribution of tree sizes and species in the plantation.

A plantation survey is performed to determine the size distribution of the plantation population. A range of measurements are performed on "shoulder trees" which represent 2/3rds (1 standard deviation) of the diameter range of the population's majority species. For example, where a population's diameters ranged from 6" - 12", but 8-10" trees make up 2/3rds of the plantation population, the shoulder tree diameter range is 8-10" DBH. Shoulder tree measurements include height, size variability, canopy and stem spacing. Each plantation is separately surveyed to determine plantation age, stocking, and tree size distribution. Retention trees are also recorded in the plantation survey and are factored into total trees per acre (TPA) in the plantation.

Level 3 Plantation Surveys

Upon reaching 15 years of age, plantations are inventoried using plots evenly assigned across a regeneration unit to achieve 1 plot per 4-acres with a 60-foot buffer on roads and unit boundaries.

These plots consist of 3 nested plots: a 20-foot radius plot for planted trees, a 10-foot radius plot for understory trees and a 50-foot radius plot for retention trees inside the regeneration unit. The Haglof is used to determine in and out trees. The diameter and height of each crop tree is measured and recorded. Detailed inventory methodology can be found in RBS 2019 Confidential Docs (Confidential_SPI_Appendix A(b) Requirements.docx)

c) Plot Monumenting and Field Measurements

Plots are located using a Garmin® GPS device, however additional aid can be used from field maps. Upon arrival at the plot center, the cruiser opens the iPad proprietary cruise application and scrolls through the indexed plots or searches for the unique plot ID that corresponds to the located plot center. Once plot centers have been determined they are marked by a stake flag and labeled with plot ID, cruisers initials, and the date (e.g. 0209, CBJ, MM-DD-YR). Flagging is then attached to a nail and pushed into the ground at plot center. When hazardous conditions (e.g. cliff, wildlife, marijuana cultivation, etc.) are present on plot preventing safe data collection, cruisers will register the plot as an "Empty Plot" making a conservative estimate of carbon stocks.

At each plot, the Criterion scope is used to determine candidate trees, and the Haglof laser verifies each candidate tree using diameter and distance from plot center to measure as tally trees. As any candidate tree not meeting the minimum diameter given by the Haglof and/or not merchantable size (8-inch DBH and greater) will not be measured. Several additional measurements are then performed on the largest two conifer trees occurring on each plot (Table 6).

Table 6: Required Tree Measurements

Measurement	Attained by	Description
Species	Visual Evaluation	Unique biological classification for each tree
DBH	Loggers Tape	Diameter of the bole at breast height (4.5 ft above the ground) measured to the nearest tenth of an inch (0.1")
Broken Top	Visual Evaluation	No (default): Full top that shows no visible sign of a broken top Yes: Top is missing, broken, or hanging
Tree Class	Visual Evaluation	101 (default): Green/live tree 102: Green cull tree; spike top or significant log decay 104: Green tree with half or more of the canopy brown/dead. 105: Dead tree with branches present. 106: Dead tree with majority of branches missing, but bark still present. 107: Dead tree with significant decay (e.g., no branches and bark)
Height[1]	Haglof	Measured height of the tree to the nearest tenth of a foot (0.1')
Merch Height[1]	Haglof	Merchantable cutoff height of the tree

Logs	iPad calculates	Number of 16'6'' length merchantable logs attainable
Defect	Visual Evaluation	Percentage of defect per log in 10% increments
Age[2]	Increment Borer	Measured at DBH (4.5 ft above the ground) by coring into the pith of the tree and counting rings to determine age
PAI-10[2]	Increment Borer	Measured 10-yr periodic annual increment to closest 10th of an inch

[1]Only measured on the two largest conifers per plot.
[2]Only measured on Site trees, 1 every 3-4 plots.

Defect is assessed as a percentage on each log and recorded in 10% increments. Common defect agents include crook/sweep, forks, heart rot, cat's face, burls, various fungi species, bark beetle damage, fire, frost, and mechanical damage.

Site tree data is collected with approximately one site tree every three to four plots. Trees identified as site trees display the following characteristics: dominant or co-dominant, healthy, receiving full light from above and partly from the sides, having well-developed crowns, minimal to no top damage, and having an age of 50 years or greater.

Cruisers are also check cruised daily (10% of the plots) to ensure accuracy of measurements and data.

d) Initial Stratification

The initial stratification process began with an updated landclass GIS layer representing the specific forest project's initial reporting year. Landclass types classified by SPI represent similar stands depending on merchantability and past silviculture treatments/disturbance that result in plantations (Table 7). Landclasses are maintained at the parcel level and end at all parcel boundaries. A landclass is the smallest unit managed (0.01 acres or greater) and is annually updated at a minimum scale of 265-ft-per-inch, along with other GIS layers (e.g. road network, APN parcel, section grids, THP, harvest depletion) using various sources of imagery and fieldwork. The 2010 NAIP imagery is the base imagery used to update GIS layers, however, newer imagery datasets are used when the above listed land features are not visible on the 2010, but visible on the newer imagery dataset (e.g., 2016).

Table 7: Landclass Types Classified by SPI

Landclass	Description
Mixed	Mixed Stands with merchantable timber.
Limited Option 0	Extremely sparse tree density; extremely low merchantability volume.
Limited Option 1	Irregular stocking and tree density with openings of usually 1-acre or more.
Non-Timber	Open grounds, cliffs, meadows, lakes, etc.
Regeneration	Land that has been previously harvested or lost due to disturbance (e.g., fire) and will or has been replanted into a plantation.

Once the updated landclass GIS layer has been finalized, it is intersected with the project boundary to provide the foundation for the project area stratification. Landclasses of the same type (e.g., M and R) and if applicable, age (if a Regen landclass), are then aggregated (adjacently at first) to create 80-acre polygons (Base-80s). Base-80s are then typed/filled with their intersecting plot data. Once Base-80s are populated with their corresponding plot data, stratums are built into four main types (M, R, L1, and NON) however M and R stratums are classified further. M stratums are classified based upon their dominant conifer species and basal area/acre, and R stratums are classified based on their plantation age (Table 8).

Note: Figure 4 below details the 2021 stratums for the project area (split between the North and South of the project area).

Table 8: Stratum Name Qualifiers

<table>
<tr><th>Stratum</th><th>Part 1</th><th>Part 2</th><th>Part 3</th></tr>
<tr><td>M

Example: M_DF_150</td><td>Landclass type:
Mixed

“M_”</td><td>Dominant Species Group Species: Below is a criteria list asked top-down (based on basal area):
<table><tr><td>PP</td><td>Ponderosa Pine</td><td>≥ 0.50</td></tr><tr><td>DF</td><td>Douglas Fir</td><td>≥ 0.50</td></tr><tr><td>WF</td><td>White Fir</td><td>≥ 0.50</td></tr><tr><td>MC</td><td>None above ≥ 0.50</td><td></td></tr></table></td><td>Basal Area/Acre: Total basal area per acre rounded to the nearest 25th.</td></tr>
<tr><td>R

Example: R_20</td><td>Landclass type:
Regeneration, plantation

“R_”</td><td>Plantation Age (5-year increments):
<table><tr><td>0 = 0 years old</td><td>11-15 = 15 years</td></tr><tr><td>1-5 = 5 years old</td><td>16-20 = 20 years old</td></tr><tr><td>6-10 = 10 years old</td><td>21-25 = 25 years old</td></tr></table></td><td></td></tr>
<tr><td>L0 & L1

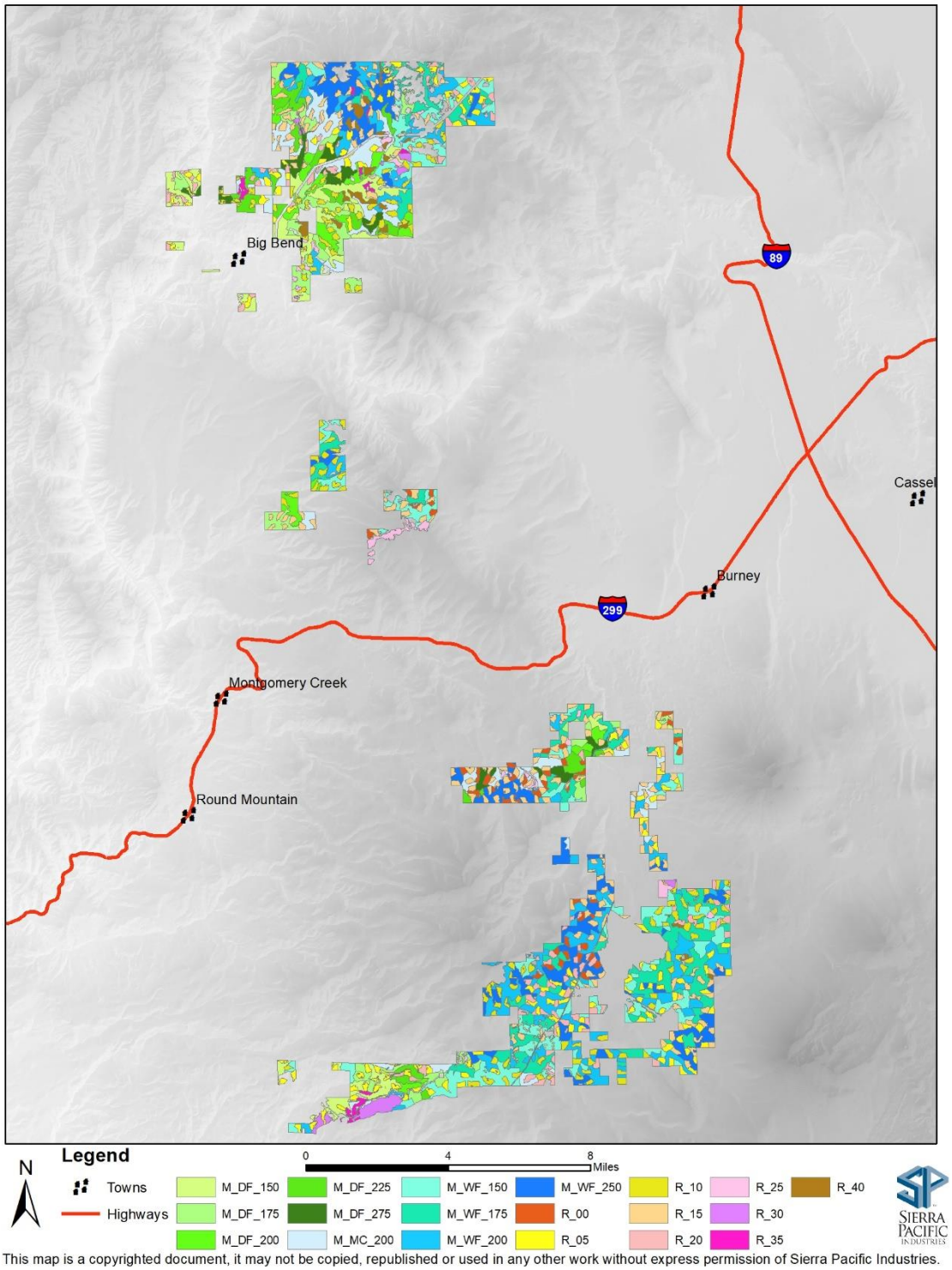
Example: L1_05</td><td>Landclass type:
Limited Option 1

“L1_”</td><td>“05” is just a place holder. All L1 landclass units are aggregated into this stratum.

Note: Limited Option stratums are not included in the project area, therefore not analyzed.</td><td></td></tr>
<tr><td>NON

Example: Non_Timber</td><td>Landclass type:
Limited Option 0 or Non-Timber</td><td>Note: NON stratums are not included in the project area, therefore not analyzed.</td><td></td></tr>
</table>

RBS 2019 (North) Forest Stratums



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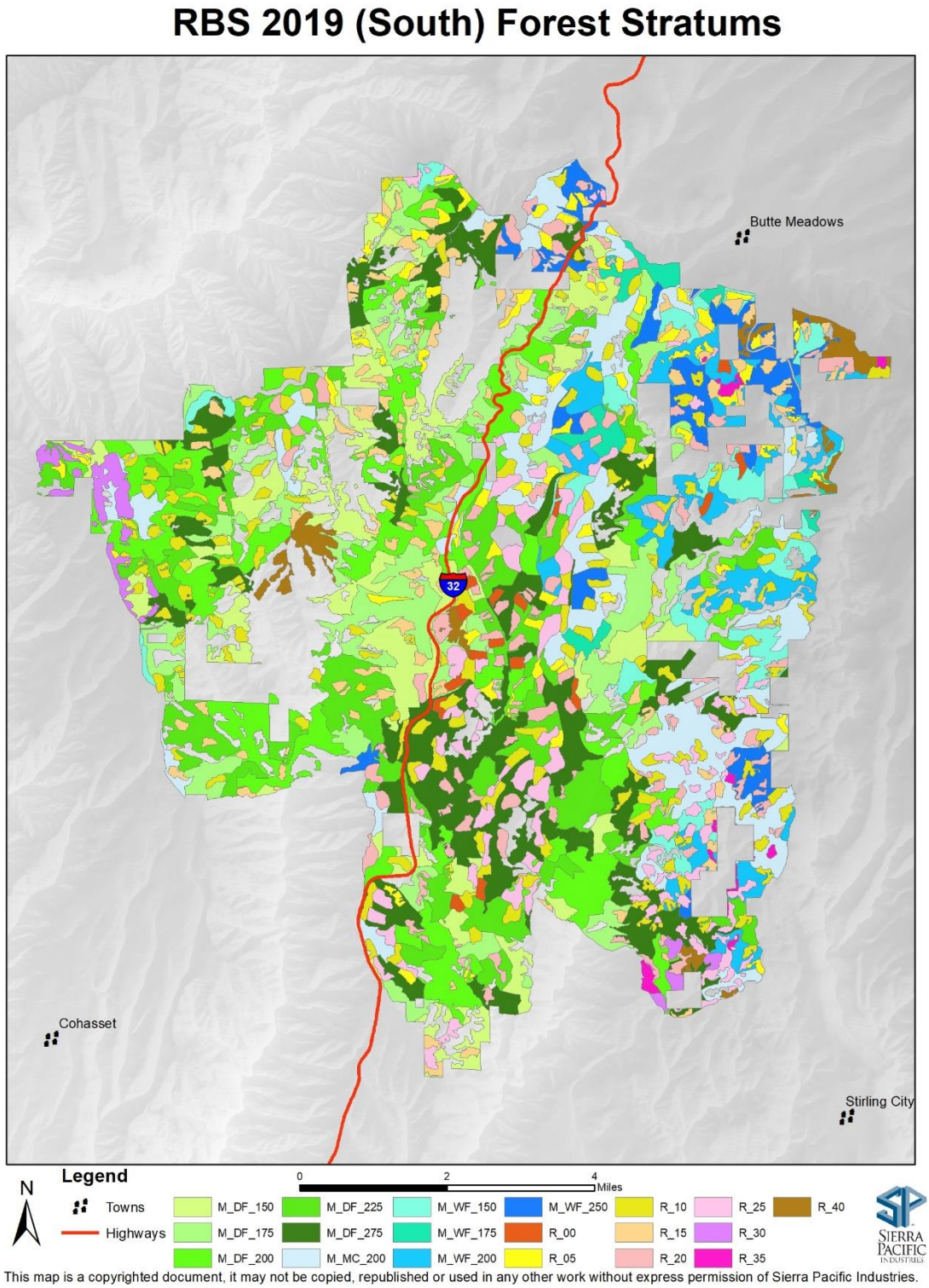


Figure 4 – RBS 2019 IFM 2021 Strata Maps

e) Data Management Systems

i. Field Data

Collected inventory data is recorded in our proprietary iPad software, downloaded nightly from the field, and then imported into a specialized inventory management system (IMS). Some data checking is natively triggered as the timber cruiser inputs data into the software, requiring the cruiser to fix or confirm the input. Various native routines within IMS are performed to query imported data for erroneous or incomplete data.

After field data is imported into IMS and quality assurance is complete, tree height is estimated for all cruised trees where height was not measured using inventory constructed height regression models that are specific for each species, region, and elevational zones if applicable (Low = <5,500 ft, High = >5,500 ft) following model forms from Hui and Gadow (1993).

Cruise plot positions are placed in SPI's Geographic Information System (GIS) and linked to cruised inventory data. GIS datalinks are reviewed to ensure spatial relationships are tight and complete.

ii. Growth and Yield Model

GPI, a proprietary planning model, inherently manages all modeled results from scenarios consisting of prescribed harvesting and growth events. Scenarios are professional driven course of actions on a specific area (land class) within a stratum in the project area. A single stratum can house a multitude of scenarios which have a minimum of 20 growth events for the 100-year planning period (period represents a 5-year interval). However, for some scenarios there may be up to 30 or more events (including growth, harvesting, and ingrowth events).

Year-0 tree lists (starting condition inventory; 15-Oct-2019) were created at the scenario level when a scenario had 3 or more plots associated with them, however when a scenario had less than 3 plots a stratum level tree list was prepared. The method of creating scenario level tree list, when possible, resulted in the 97% of the project area being modeled with inventory directly linked to a scenario instead of the entire stratum tree list. In R-stratum scenarios where multiple regen tree populations (i.e., crop, understory, and retention) were present in plots, two separate scenarios were developed to model each population accurately. One scenario modeled the crop trees and the other scenario noted by “USY” in the events table modeled the understory and retention. Scenarios were then designed and evaluated for all project area landclass in GPI. Scenario inventory data is altered by each scenario’s events. In the modeling effort, GPI manages the inventory, harvest, and growth results for each scenario. CACTOS DLL (Cactos32.dll from FORSEE_Build21_010611; DLL’s properties: Version 1, Date Modified: 1/6/2011, and a release date of the documentation: 5/2011**,** herein noted as CACTOS) is the principal model called within GPI and an ARB approved growth model. This model has been designed to simulate stand and tree-growth changes, including mortality (Wensel et al. 1986).

CACTOS allows the enabling of mortality, as well as assigning a multiplier from 1 to 5. However, CACTOS does not update or forecast dead trees. CACTOS uses a stochastic method of reducing the tree

expansion factor by the probability predicted by the logistic model (CACTOS Research Note #24). Therefore, CACTOS was not used to update or forecast dead trees, which is beyond the scope of CACTOS. Mortality was not enabled in CACTOS, and therefore, standing dead above-ground biomass remained static in the baseline model.

For baseline modeling, all outstanding approved THPs within the project area pending harvest completion are recognized and applied before modeling. Additional commercial harvesting is anticipated to occur on project land during the scope of the project. The forestlands associated to this project and remaining forest owner's landholdings are managed under an approved "Option A" demonstration of Maximum Sustained Production (MSP) and is on file with CDF. The approved "Option A" integrates various management practices providing a range of seral stages across the forest project owner's landholdings.

Note: MSP for the baseline modeling was also based on "Option A" and in addition to retaining the required basal area stocking standards, and seed trees if applicable, for the given silviculture.

CACTOS & STP Growth Projections

GPI uses CACTOS to simulate growth inherently every 5 years from Year-0 to Year-100 for all M-stand inventory. For example, to simulate growth from Year-5 to Year-10, GPI isolates specific tree attributes from the Year-5 stratum tree list's DBF (e.g., species [spec_id], diameter at breast height in inches [pre_dbh], tree height in feet [pre_ht], trees per acre [pre_freq], Conifer (T or F) [Spec_group], crown ratio [Pre_Crown], and site [Calc_site]), and passes this information to CACTOS. CACTOS returns an updated tree list grown for 5-years, which is stored in memory. Systematically, each record in memory is gathered and programmatically aligned to the corresponding record to update the Year-10 tree list in DBF format (below, refer to input tree list of Yr5 that is grown to an output tree list Yr10).

Yr5

Plot_id	Mtrssp	Stratum	Calc_site	Tree_id	Spec_id	Spec_name	Spec_group	Pre_dbh	Pre_ht	Pre_crown	Pre_freq	Mg
29569	M41N01E200620	MA18_180	92	134509	3	White Fir	A	36.1052	131.3622	78.2198257446	3.464	0
29569	M41N01E200620	MA18_180	92	134510	3	White Fir	A	31.5211	120.1381	68.4454040527	5.996	0
29569	M41N01E200620	MA18_180	92	134511	3	White Fir	A	39.8116	137.7554	69.7312393188	3.623	0
29585	M41N01E200816	MA18_180	86	134588	27	Black Oak	B	7.1061	39.0678	52.9819145203	227.871	0
29585	M41N01E200816	MA18_180	86	134589	27	Black Oak	B	11.6236	51.9832	52.6515312195	101.422	0
29585	M41N01E200816	MA18_180	86	134590	3	White Fir	A	34.3679	127.2007	78.7045898438	0.985	0

Yr10

Plot_id	Mtrssp	Stratum	Calc_site	Tree_id	Spec_id	Spec_name	Spec_group	Pre_dbh	Pre_ht	Pre_crown	Pre_freq	Mg
29569	M41N01E200620	MA18_180	92	134509	3	White Fir	A	38.0677	137.1391	76.6808395386	3.446	0
29569	M41N01E200620	MA18_180	92	134510	3	White Fir	A	33.5086	126.1207	67.1249465942	5.949	0
29569	M41N01E200620	MA18_180	92	134511	3	White Fir	A	40.8221	141.4909	69.4999465942	3.596	0
29585	M41N01E200816	MA18_180	86	134588	27	Black Oak	B	7.4092	43.4016	55.5900344849	227.650	0
29585	M41N01E200816	MA18_180	86	134589	27	Black Oak	B	12.4067	58.1602	55.0047569275	101.356	0
29585	M41N01E200816	MA18_180	86	134590	3	White Fir	A	36.5657	133.1545	77.5965270996	0.980	0

Stand Table Projection (STP) is called in GPI and is used to project growth on crop trees in R-stratums. STP was developed as a regeneration model to project tree sizes for known stocking and species

composition over a range of site conditions ("management site"). STP uses coefficients (e.g., height Increment & rings per inch increment) to project height and DBH growth. The coefficients are species independent, with height, DBH, and site index being the only required tree parameters.

Site Classes

A 50-year site index value is calculated (CACTOS Research Note #8) and stored in IMS for each plot. Site is first calculated for each M-plot with measured site trees following an algorithm for trees in a mixed conifer forest in Northern California from Biging and Wensel, 1984. A weighted average site is then calculated for each M-plot without site trees based on distance from the site tree plot(s). Plots with site trees are found within multiples of the 4x10 chain grid, skipping the 10's (10, 30, 50), until 5 site trees have been found or its traveled 2 miles to calculate the weighted average site for that plot. Plots in each stratum would inherit its calculated 50-yr site index value, except for R stratums, and therefore a stratum would contain multiple site index values. However, FORSEE recommends averaging all site trees and running an average across the stand. Therefore, the site index was averaged using all plots within all M stratums and separately for all R stratums based on a weighted average on the number of plots and their corresponding site in each Township, Section, Range. Thus, an averaged site index was used for growth across all species within IMS and GPI across the project.

This site index expresses the growth potential for all species for a given plot. However, in GPI there are two DBF tables that house all scenarios (Scens.dbf) and events (Events.dbf), and the actual used site index would be based on a value the user enters within the event table for a given growth event as detailed below:

1. If a letter "C" or "calculated site" is used for a growth event, the site index would directly be read from the "Calc_Site" field within the tree list.
2. If a letter "M" or "management site" is used for a growth event, the site index would directly be read from the "Mgmt_Site" field within the tree list.
3. If an actual number is used, such as 85, that "expected site" index is used. In the case of R stratums, the user entered a value of 85.

For M stratums the site defaults to the average calculated site and does not change during the 100-year planning horizon unless the silviculture prescription involved a clearcut at which time a "management site" was applied.

Plantations used an expected site index of 70-110. Since no actual site trees remain in plantations and based upon the growth performance in existing plantations (R-stratums), SPI felt it was professionally responsible not to directly use the site values measured on the previous plantation cruise data and to grow plantations in the model at the expected site as being demonstrated in consideration of existing plantations.

Model Calibrations

Throughout the 100-year modeling, one or more calibration files were considered and assigned to achieve growth estimates, which were based on stand conditions and site, and considering various California cooperative research, measured trees from inventory, and Elliot Ranch published results of high density stands (Table 9). The forest project focused on investment interventions such as planting, superior tree seed collection, desired density control, and vegetation management that directly improve tree growth and inherently leaf biomass production. However, the baseline was calibrated to obtain growth-estimates which are inherently less due to less-than-optimum growing and tree conditions relative to the forest project. Baseline scenario development emphasized the minimizing of stand-improvement investments, with the goal of maximizing commercial-harvest while considering required stocking standards and the minimum baseline level (MBL).

Growth of mixed stands (M-stratums) was modeled via a proprietary CACTOS DLL. Based on the project location, CACTOS regional calibration Zone #2 (REG2) is provided as a default calibration that is based on a broad area. “STR_M” and “MRED_M” calibrations are based upon SPI’s measured and site trees performance, and from relatively more localized area that straddles specific SPI management districts of the project area. Using a localized dataset based upon measured tree growth results was considered a more appropriate calibration than using the CACTOS default.

Growth of crop trees in plantation stands (R-stratums) were modeled based on a stand table projection (stand table projections meet the requirements of the FOP Appendix B-1 pg. 90-91). Regeneration yield data compiled from large-scale ownership-wide measure and site trees, and considering various California cooperative research, and Elliot Ranch plots published results of high density stands all were used as the source to calibrate growth based on stand conditions (e.g., site, trees per acre, tree size, age, and species). Growth of regen understory and retention trees were calibrated to achieve only 10% of normal STR_M or MRED_M tree growth given the competition from planted crop trees and subsequent management of them.

Table 9: Growth Model Calibrations

Model	Calibration	Note
CACTOS	STR_M or MRED_M	These calibrations were used for mixed stratums and understory/retention in regen stratums. CACTOS regional calibration Zone #2 (REG2) is provided as a default calibration that is based on a very broad area. “STR_M” and “MRED_M” calibrations are based upon SPI’s measured and site trees that trumps the number of sample plots and trees used to create “REG2”, and “STR_M” and “MRED_M” is also relatively more localized that straddles the project area.
STP	H_PRIN	Applied on existing R-stratums or all baseline clearcut units until the stand is commercially thinned.

CACTOS	CACE_H	Applied to R-stratums after commercially thinning and used up to the point the R-stratum is transitioned to an uneven-aged stand (mixed stand), at which time, "STR_M" or "MRED_M" is used to year 100.
CACTOS	ECAP	Used on high basal area R-stratums. For the baseline, this was used only within WLPZ portions of 10-units totaling about 11-acres. The use of this calibration started about age 55 or later. The height and dbh increment were professionally reduced to recognize this very high basal area stand condition.
CACTOS	RET_R	Used on R-stratum understory and retention trees in a plantation ("USY" scenarios). This calibration achieved only 10% of STR_M/MRED_M growth to reflect the competition from faster growing crop trees in the scenario and the subsequent management of them.

f) Quality Assurance and Control

Field data that has been QA/QC and entered into IMS, goes through maintenance every year based on depletion, disturbance, growth and/or new cruise inventory. During each IMS annual update, IMS is reconciled with supporting GIS layers to ensure correct associations to allow for precise data management and maintenance. The IMS annual update is managed in a consistent chronological series of steps to ensure proper accounting and consistency of inventory data each year. Following the completion of the IMS annual update, archives of each year's inventory beginning on January 1st of every year are stored across internal servers, Dropbox, and localized hard drives for backup purposes.

Quality assurance and control measures are also leveraged in the data analysis phase. The Carbon Program was built internally to rapidly analyze tree/plot/stratum volume and biomass using the standardized coefficients and equations set forth by the Forest Inventory and Analysis (FIA) Program of the United States Forest Service. This program went through extensive QA/QC checks for each species and eliminates most human error, as all equations and coefficients are hard coded in the software. The program does go through a "check-run' before any projects data is leveraged to check for inconsistencies or errors. Results from The Carbon Program are then inputted into an Excel "calcs" book, to further aggregate and analyze the data. These books are project specific and are checked prior to submission for errors in data links and equations.

5 – Quantification Methodology

a) Baseline Modeling Plan

A 100-yr modeling plan was prepared addressing all required forecasting and updating of actual inventory at project commencement through time. Management timing is first based on recognizing outstanding submitted THPs (above, refer to commencement THPs table), and then modeled uneven-aged management for the remaining area starting at year-0. Management in the remaining periods is then limited by legal constraints (Appendix B). Protection areas are timed with entries of the upslope portion of unit. Management and silviculture timing were based on stand conditions. Stratum's straddle multiple site classes, with the minimum of Site V for regen stratums, but also consisting of Site I & II for mixed stratums. To accommodate the existing site variations within a stratum, a minimum retention standard for a given silviculture was based on Site I, II, and III; in most cases equaling or exceeding Site II.

For M-stratums the modeled silviculture prescription involved uneven-aged management every 5 years, starting at year-0, using selection harvest. R-stratums or new clearcuts, harvest timing varied based on age, tree size, and density, but the silviculture prescriptions generally consisted of commercial thin, transition, and then selection. The coordination of the silviculture prescriptions focused on adjusting the initial even-aged stand to a stand condition more representative of uneven-aged. The silviculture, and the associated stocking retention constraint per Article 3 of CAL FIRE (2019) are discussed below and were modeled to meet or exceed the silviculture's minimum stocking standards.

1. **Clearcuts (CCUT):** Outstanding THPs at project commencement with clearcut silviculture were modeled at Year-0. Prior to the clearcut, an average of 2% habitat retention areas (HRAs) were retained in the scenario based on the stand (strata) condition (Table 10). This would result in an overall decrease of 2% in actual acres associated to clearcut silviculture in the baseline. These retention scenarios would be modeled and harvested separately using selection silviculture but timed along with their associated clearcut scenario. All trees not in the HRA's were then removed from the inventory.

Table 10: Habitat Retention Areas (HRAs) Retained from Outstanding Clearcuts

Strata	Scn_Code	Acres	Basal Area	Trees per acre	MTCO2e/Acre (above ground live)
M_DF_150	SCN_RET_M_DF_150_AH	5.87	140.94	421.26	128.51
M_DF_175	SCN_RET_M_DF_175_AH	7.73	176.25	439.86	160.41
M_DF_200	SCN_RET_M_DF_200_AH	7.79	198.62	622.08	186.72
M_DF_225	SCN_RET_M_DF_225_AH	13.31	221.72	675.89	207.68
M_DF_275	SCN_RET_M_DF_275_AH	12.21	263.82	688.38	252.86

M_MC_200	SCN_RET_M_MC_200_AH	6.04	211.69	668.73	197.01
M_WF_150	SCN_RET_M_WF_150_AH	8.02	143.99	411.29	127.21
M_WF_175	SCN_RET_M_WF_175_AH	10.03	182.73	381.43	164.92
M_WF_200	SCN_RET_M_WF_200_AH	10.50	210.72	446.69	188.54
M_WF_250	SCN_RET_M_WF_250_AH	13.02	252.55	588.04	228.78
	TOTAL:	94.51			

2. **Commercial Thin (CTHL)** occurs once tree sizes are generally merchantable typically around 50-years of age and when preharvest dominant and codominant crown canopy are occupied predominately by trees greater than 14" in DBH. It is expected that the modeled commercial thinning improves stand health, that would otherwise be lost through overstocking. Minimum stocking standards were based on Site I mixed conifer lands and residual stands were either 125 ft^2 or 100 ft^2 when it was greater than 50% pine, and Site II mixed conifer lands with residual stands left with either 100 ft^2 or 75 ft^2 when it was greater than 50% pine.

3. **Transition (TRAN)** silviculture involves removal of trees individually or in small groups from unbalanced or even-age stands to create a more balanced stand (e.g. improved stocking conditions and providing opportunities to introduce age classes through natural growth). The initial transition would be a minimum 5 years post the commercial thin, and the second transition would be 10 years after the first transition. At each transition, the preharvest stand condition would have no more than 50 ft^2 of basal area greater than the selection basal area standards. Ingrowth was added 15-yrs post the initial transition harvest to simulate natural reproduction with the assumption of 100% success of roughly 200 trees per acre. Below is the species and size distribution (DBH) of trees per acre associated to a typical transition ingrowth event in M_DF_275.

Trees per Acre								
DBH	PP	SP	WF	DF	IC	MC	HW	**Total**
1	14.77	-	42.98	41.64	22.82	1.33	10.74	134.30
2	2.72	-	7.93	7.68	4.21	0.24	1.97	24.75
3	2.49	-	7.26	7.04	3.85	0.22	1.81	22.69
4	1.58	-	4.62	4.48	2.45	0.13	1.14	14.42
5	0.90	-	2.64	2.56	1.40	0.08	0.65	8.24

6	0.22	-	0.65	0.64	0.34	0.01	0.16	2.04
Total	**22.70**	**-**	**66.10**	**64.04**	**35.09**	**2.02**	**16.49**	**209.46**

PP: Ponderosa Pine, SP: Sugar Pine; WF: White Fir; DF: Douglas Fir; IC: Incense Cedar; MC: Other Conifer; HW: Other Hardwood.

4. **Selection (SELE)** initiated about 15 to 20 years following the transition entry or on M-stand scenarios to improve stand structure and encourage the opportunity for natural reproduction. The modeled post-harvest conditions predominately had a minimum stocking standard of 75 ft^2 (Site II and III) and at least 15 ft^2 of seed trees. All trees' sizes were cut in the model and retaining a distribution of tree sizes to simulate an uneven-aged-stand structure. Successive selection harvests were simulated every 5-20 years. All trees' sizes were cut, but with some emphasis on the small and large trees, to simulate creating holes to encourage natural reproduction through ingrowth and to improve growing conditions for the remaining trees. Ingrowth was added to simulate natural reproduction based on 20-year intervals if the post-harvest canopy closure became less than 50%. Approximately 50 trees per acre were added from the ingrowth with a species composition based on the actual species presence, with the assumption of 100% seedling success rate. Below is the species and size distribution (DBH) of trees per acre associated to a selection ingrowth event in M_DF_275.

Trees per Acre								
DBH	**PP**	**SP**	**WF**	**DF**	**IC**	**MC**	**HW**	**Total**
1	3.93	-	11.46	11.10	6.08	0.35	2.86	35.80
2	0.72	-	2.11	2.04	1.12	0.06	0.52	6.58
3	0.66	-	1.93	1.87	1.02	0.06	0.48	6.03
4	0.42	-	1.23	1.19	0.65	0.03	0.30	3.82
5	0.24	-	0.70	0.68	0.37	0.02	0.17	2.18
6	0.06	-	0.17	0.17	0.09	-	0.04	0.53
Total	**6.04**	**-**	**17.61**	**17.06**	**9.33**	**0.52**	**4.37**	**54.96**

PP: Ponderosa Pine, SP: Sugar Pine; WF: White Fir; DF: Douglas Fir; IC: Incense Cedar; MC: Other Conifer; HW: Other Hardwood.

4. **Watercourse Protection (WLPZ)** harvest was spatially timed with the associated upslope unit. In addition to having a near average Site I minimum retention standard of 120 ft^2 (group A and B). All trees' sizes were cut in the model and retaining a distribution of tree sizes to simulate an uneven-aged stand structure. Modeled WLPZ widths were based on "imprints" on imagery or in cases the imprint is not visible, WLPZ widths shall be based on the FPR widest WLPZ buffer afforded for the given watercourse classification and if applicable, anadromous salmonid protection. Class III watercourses were modeled with a general width of 50' from the point of

imprint extending downstream. FPR standard protection for Class III is an equipment limitation zone (ELZ), and not a WLPZ and therefore should also be deemed conservative.

5. **Fuelbreak (FUEL)** silviculture was applied when identified from outstanding THP's. The target was to remove smaller vegetation and fuels to create a shaded fuel break to reduce the potential for wildfires. The retention target was 50 ft^2 with small understory trees (less than 8" DBH) and large trees (greater than 40" DBH) being removed first. After the small and large trees were removed, the basal area was reduced to achieve an even distribution across DBHs until reaching the target of 50 ft^2.
6. **Shelterwood (SHRS)** was applied when identified from outstanding THP's. Target was to remove overstory trees and thin the understory and retain 85 ft^2 in the scenario.
7. **Existing Regen "Retention Islands":** Regen age 0 and older which show "retention islands" on the 2016 NAIP imagery were modeled with 2% retention represented by an averaged stand condition of all M-strata within the project (Table 11). This was accomplished by reducing associated regeneration strata acreages by 2% and adding a "generic" stratum, "M_RET_00", of equal acreage with a stand condition based upon the average M-strata since the actual older cut strata (preharvest stand condition) is no longer available to use as a basis for this stratum. This approach recognizes that islands exist in older clearcut units as well, not just uncut clearcut units at the start of the project. Each "retention island" scenario consisted of growth & harvest events for 100 years in the baseline modeling. The retention stratum will be grown each year to remain current with other stratums for each growth period. The harvest entries (selection, etc.) within the "retention islands" were timed with the commercial entries of the associated regeneration unit.

Table 11: Retention Islands Modeled in the Baseline

Strata	Acres	Initial Basal Area	Initial Trees per acre	Initial MTCO2e/Acre (Above ground live)
M_RET_00	455.39	194.79	347.71	185.22

Note: Refer to "RBS 2019_Projected Harvest.xlsx" for a summary of project acres treated and total Scribner with each silviculture treatment throughout the baseline model.

Assumptions for Baseline Modeling

1. Tree harvesting in the modeling can be categorized as direct or indirect tree removal. Direct tree removal represents trees removed specifically by harvesting, where the latter is to simulate the loss of trees due to harvest damage. The amount in indirect tree removal is disproportionate and consisting of a range of sizes and species.

2. Natural regeneration (ingrowth) is added into the stratum when canopy closure drops below 50% after a harvest. Adding ingrowth occurred 15 years post the initial harvest and then evaluated at 20-year intervals with 100% success rate.
3. No mortality is used.
4. Planting of clearcuts in baseline is represented by non-precommercial thin condition 10 years after the clearcut with 100% success rate.
5. No harvesting is done within the first 30 feet of the 200 ft buffer of Class I WLPZ units that require anadromous salmonid protection (ASP).

b) Above-Ground Standing Gross Biomass

Above-ground standing live and dead gross biomass (AGB) was calculated using the appropriate species-specific FIA regional (California) volume and biomass equations (dated 09-19-2014) using a proprietary software program called, The Carbon Program. These equations rely on current DBH, and in most cases, total tree height as the two dependent variables. All total stem volumes (CVTS) were calculated for all live trees in the inventory greater than or equal to 1" DBH and on all dead trees greater than or equal to 5" DBH. For broken top trees, bole volume was calculated to account for the missing volume of the broken top using the estimated total height of the tree. Total stem volume (CVTS) was then used to calculate the biomass of the tree stem by looking up each trees wood density value and multiplying that by its CVTS and then dividing by 2000. Additionally, bark and branch biomass were calculated using their regional-species specific bark and branch biomass equations, if applicable.

Total Gross Biomass above ground (bole, bark, & branches) is also converted from US tons to metric tons by multiplying by 0.90718474. Biomass is then converted to carbon by multiplying by 0.5 and then $C0_2e$ by multiplying by 3.667.

Note: Some hardwood species volumes are calculated using the Pillsbury equations which means CVTS includes bark and branches.

c) Above-Ground Standing Net Biomass

Above-ground standing gross biomass is adjusted for both live and dead trees to attain net biomass remaining using broken top % defect, and if dead, density reduction factors (Harmon et al. 2011). Tree biomass is proportionally weighted by dividing the tree height in thirds and assigning the following weight: 65% at the bottom, 25% in the middle, and 10% at the top (Climate Action Reserve, 2014). Broken top trees are all taxed as 50% broken tops based on results from previous verifiable broken op trees, which accounts to roughly a reduction of 23% biomass for each broken top tree.

Standing dead trees were then cross walked based on if hardwood or softwood, and SPI tree classes to Harmon et al. (Table 6, 2011) average density reduction factors. Tree class 105 was referenced to Decay class 1, 106 to Decay class 3, and 107 to Decay class 5 respectively. Net biomass is then calculated for every tree by taking the missing volume % defect (broken top defect %) and subtracting it from 1, then

multiplying that percent remaining by the gross AGB for that tree. If the tree is dead, then that value is also multiplied by its appropriate density reduction factor to attain the Net Biomass.

d) Below Ground Biomass (BGB)

The Cairn's equation 3 was used to calculate biomass in the below-ground portion in tonnes per hectare (Table 3, Cairns, Brown, Helmer, & Baumgardner, 1997). The below-ground biomass is calculated at the plot level using the sum of live and dead above-ground biomass. Once the plot level total below-ground biomass has been calculated, it is then allocated to the live and dead carbon pools based on the percentage of each carbon pools above-ground biomass. These values are then converted back into acres by dividing by 2.47105.

Note: All biomass and volume equations for individual trees are calculated in The Carbon Program (last revision February 20, 2020). This program also aggregates the data at the plot level to appropriately calculate below ground biomass and calculate total volumes at the stratum level.

e) Inventory Update Process

The forest project's inventory plots were updated and maintained as current by first reconciling various GIS layers, and then depleted & grown, and integrating new cruises (if necessary). The same sequence would be applied to update the inventory to support each annual reporting period. As noted above, all collected qualitative and quantitative inventory data is stored and updated in IMS.

i. GIS Layer Reconciling and Updating

Prior to updating inventory cruise data, GIS-spatial information (e.g., road networks, streams, THPs, land classes, disturbances, and administrative boundaries) reconciled on an annual basis using NAIP imagery datasets, as well as using any collected field information. Several primary imagery datasets are used, with the most recent imagery dataset being 2020. The 2010 imagery is the base imagery for the GIS reconciling. The newer imagery dataset is used when the above listed land features are not visible on the 2010, but visible on the newer imagery dataset. Updating or reconciliation of GIS layers is performed at a minimum scale of 265-ft per inch. An imprint from new even-aged cuts along ownership boundary provides a direct source in reconciling ownership and section-grids.

ii. Growth, Depletion and Disturbance

A GIS THP Layer (CDF approved THPs) with all unit-boundary details and silviculture is routinely updated throughout the reporting period and maintained at the project level. Depletion information (THPs, residual stocking, etc.) is requested and provided by SPI Registered Professional Foresters to ensure that all harvest throughout the reporting period has been accounted for. At the THP or silviculture unit(s) level, inventory is depleted accordingly throughout the reporting period in a graphical environment within IMS, by diameter and species group. Depletion is performed while simultaneously monitoring stand conditions, stocking requirements, and Professional Forester's information. The tree's tree frequency is adjusted based on the percent (%) cut results from the graphical environment which are applied by diameter and species group. Tree classes would also be updated from live to dead if needed

based on any residual stocking information attained. The same methods would be applied to update the inventory due to any sort of abiotic and biotic disturbances (e.g., fire or severe insect outbreaks leading to mortality). After depletion of the inventory (if necessary) the inventory is annually grown forward 1-year via CACTOS in IMS.

As noted above, imagery data sets are used to update various GIS layers, including landclasses, as well as visible Regeneration Units (even aged silviculture, e.g. CCUT, RHAB) from THPs, fires, or rehabilitation activities. Those Regeneration Units not visible on orthos are field reviewed and GPSed if timing is allowed. The collected GPS points are overlaid and leveraged to adjust Regeneration Units boundaries and other associated GIS layers. If timing is not allowed, the THP boundary is used. In both cases, the unit boundary shall be updated using the latest imagery datasets when they are harvested.

The GPS boundaries are considered placeholders and are used only until updated NAIP images are available and can be used to delineate the unit. All inventory data in recent regeneration cuts are 100% depleted, even though, in most cases, some residual trees are retained on the ground as habitat retention areas (HRAs) within regeneration cut units. Therefore, the forest project C02e within these regeneration units should be deemed as conservative.

iii. Updating Stratification

Each year stratums from the initial stratification process are adjusted primarily when even-aged silviculture is performed or additional WLPZ details are obtained from THPs. Also, R-stratum acres could dynamically change as regen units age overtime to each reporting period. New stratum acres are used to expand each stratum stand results, which their results shall be summed and divided by total acres to derive an overall weighted average for the forest project to support each reporting period.

iv. Integrating New Cruises and Retiring of Plots

Lastly, any new cruise inventory is incorporated into IMS, replacing the previous plot information. This Inventory is deemed as the most accurate and thus positioning the inventory to the next reporting year. Inventory plots shall be remeasured no less often than every 12 years.

All plots that have a last cruise date of greater than 10 years would be flagged for immediate re-cruise. If the plot reaches the threshold of greater than 12 years old, it would be retired until cruised again.

6 – Baseline Carbon Stocks (IFM Private Lands)

a) Legal Constraints

In California, generally the constraints affecting forest management activities are embodied in the California Forest Practice Rules, Z'Berg-Neiedly Forest Practice Act, California Endangered Species Act and the Porter-Cologne Water Quality Control Act. All applicable legal constraints that could affect the baseline growth and harvesting scenarios, were incorporated & monitored throughout the 100-year planning horizon to ensure the associated constraints are respected (Appendix B).

Anadromous Salmonid Protection

The project is not located in the Coastal Anadromy Zone. The project area is within 19 watersheds which are in Evolutionary Significant Units (ESU) for anadromous salmon species. Watersheds were then checked for total barriers that have been determined to be permanent and preclude fish passage (e.g. large dams, bedrock falls, or other natural barriers) using the California Fish Passage Assessment Database (California Coastal Conservancy, FWS and CDFW, 2019). Of the 19 watersheds analyzed, 14 watersheds contained WLPZ units that were not upstream of a barrier, therefore pursuant to 14 CCR 916.9, all Class I streams/WLPZ were buffered 100 feet on each side (total of a 200-foot buffer which exceeds the required zone width requirements). These ESU units were then modeled to maintain at least 75% canopy cover which is also conservative based on if WLPZ units were buffered into their respective zones (Core, Inner and Outer) as the required weighted average canopy cover would equal 65% (Table 12). It is assumed that no harvesting is done in the first 30 ft of the 200 ft buffer per 14 CCR 916.9(f)(4)(A), as our modeling results demonstrate a higher retention of trees and canopy closure throughout the entire 200 ft buffer.

Table 12: Modeled ESU Class I Protection

Zone Designation	Required Protection Distance	Modeled Protection Distance	Canopy Closure
Core Zone	30 ft	30 ft	100%
Inner Zone	40 ft	70 ft	70%
Outer Zone	30 ft	50 ft	50%
**ELZ*	25 ft	50 ft	50%
Required Weighted Average Canopy Closure			**65%**
Modeling Target Average Canopy Closure			**75%**

Timber Harvest Plans

Timber harvest plans (THPs) submitted before and after the offset project's commencement date were considered legal constraints for the baseline model (*Bald Skunk 2-15-050-SHA, Bello 2-18-063-TEH, Bull Durham 2-16-034-BUT, Cedar Branch 2-15-047-BUT, Dans Cow 2-18-00119-SHA, Deep Brown 2-17-074-SHA, Dry Whit 2-15-056-SHA, Goose 2-16-063-SHA, Green Whit 2-18-00149-SHA, Howards Garden 2-13-065-SHA, Humboldt 2-15-046-BUT, JB Kosk 2-13-034-SHA, Locarp 2-18-019-BUT, Mosquito 2-16-029-BUT, Musty Buck 2-18-00156-BUT, Rabbit 2-15-023-SHA, Red Peavine 2-13-083-SHA, Snow Cabin 2-14-*

076-SHA, Straw Gun 2-18-028-SHA, Terry 2-15-086-SHA, Vista Flat 2-19-00183-SHA, and Commodore 2-18-00154-BUT were identified as outstanding). The majority of THPs submitted before the commencement date have been harvested and the inventory is depleted accordingly during annual updates (Refer to Section 5.e.ii), however if silviculture remains in an outstanding submitted THP unit, it is depleted at the beginning (YR-0) of the baseline model (Table 13). Scenarios were created in GPI to represent the initial harvest event from the THP, and all other harvest events were dependent on the THP's silvicultural imprint.

A GIS layer (SPI_THP_RIS) houses all THPs that have been submitted for the project area. This layer is updated routinely by checking the CALTREES website for newly submitted THPs, therefore any THP that was submitted, but not active or approved at the time of the offset project commencement date were appropriately depleted at the beginning of the baseline model.

Table 13: Outstanding THP Silviculture

THP(s)	Silviculture	Acres
Bald Skunk 2-15-050-SHA, Bello 2-18-063-TEH, Bull Durham 2-16-034-BUT, Cedar Branch 2-15-047-BUT, Commodore 2-18-00154-BUT, Dans Cow 2-18-00119-SHA, Deep Brown 2-17-074-SHA, Dry Whit 2-15-056-SHA, Goose 2-16-063-SHA, Green Whit 2-18-00149-SHA, Howards Garden 2-13-065-SHA, Humboldt 2-15-046-BUT, JB Kosk 2-13-034-SHA, Locarp 2-18-019-BUT, Mosquito 2-16-029-BUT, Musty Buck 2-18-00156-BUT, Rabbit 2-15-023-SHA, Red Peavine 2-13-083-SHA, Snow Cabin 2-14-076-SHA, Straw Gun 2-18-028-SHA, Terry 2-15-086-SHA, and *Vista Flat 2-19-00183-SHA*	Clearcut	4,748
	Commercial Thin	140
	Fuel	307
	Selection	149
	Shelterwood (removal)	9
	WLPZ	294

Even-aged Adjacency Restrictions

The management-timing of units is first based on recognizing all outstanding harvest units from approved THPs prior to and after the commencement date. Management and timing in the remaining periods are then limited by SPI's self-imposed rule of 10-year even-aged adjacency, and the other listed constraints. In GIS, the forest project's landclasses are divided into logical logging units, and then each unit is spatially timed to ensure the 10-year adjacency rule is adhered to. Management scenarios for 100-years are developed to inherently respect the associated unit's timing. How this constraint effects forest management is basically intuitive, especially compared to the Forest Practice Rules 5-year adjacency rule. SPI's 10-year adjacency shall inherently promote increased carbon stocks relative to the Forest Practice Rules by deferring harvest entries by an additional 5-years.

Silviculture Stocking

In GPI, upon each modeled harvest event, post-harvest conditions are reported and evaluated to determine if the required Forest Practice Rules stocking standards was obtained, and if not, the harvest event is adjusted. A wide variety of pre-formatted numeric stand profiles, along with expansive statistical and silvicultural-stocking information are standard outputs from GPI. The effect of this

constraint on forest management is to ensure a minimum stocking is retained in post-harvest conditions.

Threatened and Endangered Species

Based on wildlife surveys, modeled forest management activities did not need to be constrained for wildlife due to required federal, state, or local protection measures.

b) Financial Constraints

The OPO will demonstrate financial feasibility through a financial analysis of anticipated growth and harvesting regime that captures all relevant costs and returns, taking into consideration all legal, physical, and biological constraints, using applicable (regional or documented) costs and returns for the project area.

c) Determination of the Minimum Baseline Level (MBL)

The project area is in the Southern Cascades and Sierra Nevada supersections therefore a weighted common practice was determined. Based on species composition of the project area (Table 4) the Mixed Conifer Assessment Areas (High Site) were deemed appropriate and therefore used as the common practice of the project area (Table 14).

The FPRs and offset protocol break down site classes I and II as "high", and III, IV, and V as "low". Given that the FPRs report a 100-year base age site class and SPI records a 50-year site class, the 100-year site classes reported in the FPRs were cross-walked to a 50-year equivalent from Table 9.1 in Krumland and Eng (2005). Of the 801 M-Base80s at commencement, 46 (6%) had a site class less than 67, indicative of a "low" site class. Based on this low percentage, and the project areas average M-Base80 site class of 79, it was deemed appropriate to use the "high" site class for the common practice.

Table 14: Assessment Area(s) and Common Practice Carbon Stocks

Supersection	Assessment Area	Site Class	Project Area (acres)	CP Stock	Area Weight	Weighted CP
Southern Cascades	Southern Cascade Mixed Conifer	High	72,107.07	121.77	85.96%	104.67
Sierra Nevada	Sierra Mixed Conifer	High	11,779.18	145.39	14.04%	20.41
			83,886.26 acres			**125.09**

Based on the initial forest carbon inventory for the project area, the carbons stocks of the aboveground live tree component (ICS) are calculated to be 140.24 $MTCO_2e$ per acre. The ICS is above the common practice (125.09), therefore equation 5.5 of the FOP was used to determine the MBL.

First the logical management unit (LMU) was determined to be the actual project area. Based off draft guidance from ARB, limited option and non-timber ground was removed from the project area as substantial differences in timber productivity and management goals are apparent from stratums that were included in the project area or LMU. Therefore, the weighted average carbon stocks of the LMU is equal to the initial aboveground live carbon stocks, and the MBL is equal to the common practice.

d) Estimate Baseline Onsite Carbon Stocks (Private Lands)

Baseline carbon stocks were determined by modeling the initial forest inventory for the project area in various stratum scenarios over 100 years (Refer to 5.a.i. Baseline Modeling Plan) and averaging the model results over the 100-year timeframe into a single, averaged value for each carbon stock. Gross baseline results were reduced based by a 3.00% net defect every 5-years for the project area. This net defect accounts for various growth reduction agents (e.g., drought, diseases) that the 100-year baseline does not incorporate. The result shows that baseline live above-ground biomass fluctuate through time based on management activities modeled, but average to 125.26 $MTCO_2e$ per acre, which does not fall below the MBL required by the FOP (Figure 5). Initially what is observed in Figure 5 is the harvesting of all outstanding THP's in period 0 and harvest in period 5 which causes a decline in the inventory. Pre-existing regens begin to be commercial thinned and transitioned around period 30, corresponding to a slight decline in onsite carbon stocks. The following 70 years of the model fluctuates through time as harvest and growth balance out but shows a gradual rise in onsite carbon stocks (Figure 6).

All averaged annualized baseline carbon pool values are shown below (Table 15). The final total annualized average baseline onsite carbon stocks for all pools are 13,505,609 $MTCO_2e$ or 161.00 $MTCO_2e$/acre. Refer to "RBS 2019 Baseline Results.xlsx" for the baseline model summary reported by stratums in total $MTCO_2e$ and $MTCO_2e$ per acre for each carbon pool through the 100 years.

Table 15: Baseline Carbon Stocks Results by Carbon Pool

Carbon Pool	Total $MTCO_2e$	$MTCO_2e$ per acre
Standing Live Tree Above- and Below-ground Carbon Stocks (IFM-1)	**12,911,783**	**153.92**
Standing Dead Tree Above- and Below-ground Carbon Stocks (IFM-3)	**448,827**	**5.35**
Carbon in In-use Forest Products (IFM-7)*	**88,328**	**1.05**
Forest Product Carbon in Landfills (IFM-8)*	**56,672**	**0.68**

Biological Emissions from Decomposition of Forest Products (IFM-17)*	**46,944**	**0.56**

e) Estimating Baseline Carbon in Harvested Wood Products

The average amount of merchantable carbon harvested over 100 years was calculated in 5-year increment periods from the baseline modeling following Appendix C of the FOP. Only trees with a DBH of 10" or greater were considered merchantable, and only boles were included in the analysis. Per equation C.1 of the FOP, the 100-year total baseline carbon in standing live trees that would have been harvested and delivered to mills during the 100 years was calculated. The total volume of wood (ft^3) harvested in the baseline model for each species was multiplied by the wood density factors of the Pacific Southwest region and forest type based on harvest species per Smith et al. 2006, and then converted to metric tonnes of carbon multiplying by 0.5 and dividing by 2,204.6. Lastly, this total is then annualized by dividing by 100 and multiplied by the appropriate regional mill efficacy percentages (0.568 for hardwoods and 0.675 for softwoods) to obtain an annualized amount of carbon that would be harvested, delivered to mills, and transferred to wood products in the baseline model.

Wood product classes (e.g., softwood/hardwood lumber, plywood, paper, etc.) were based on the weighted values for the Southern Cascades and Sierra Nevada supersections: 73.42% softwood lumber, 0.56% hardwood lumber, 24.16% plywood, 0.08% non-structural panels, 0.49% miscellaneous, and 1.29% paper. The annualized net baseline carbon transferred to wood products was multiplied by its appropriate wood class percentage to determine the amount allocated to that specific wood product. The amount of carbon transferred into each wood product was then multiplied by the 100-year average storage factor for In-Use Products (IFM-7) and Landfills (IFM-8) (Table 16).

Note: These values (noted by a * in Table 15) are also decreased/increased based on the initial reporting period time length, therefore these annualized results were multiplied by 1.46 to reflect the initial reporting period.

Table 16: Average storage factors used to estimate carbon in in-use products and landfills

100-yr Average Storage Factor	Softwood Lumber	Hardwood Lumber	Plywood	Oriented Strand Board	Non-structural Panels	Miscellaneous	Paper
In-Use (IFM-7)	0.463	0.250	0.484	0.582	0.380	0.176	0.058
Landfills (IFM-8)	0.298	0.414	0.287	0.233	0.344	0.454	0.178

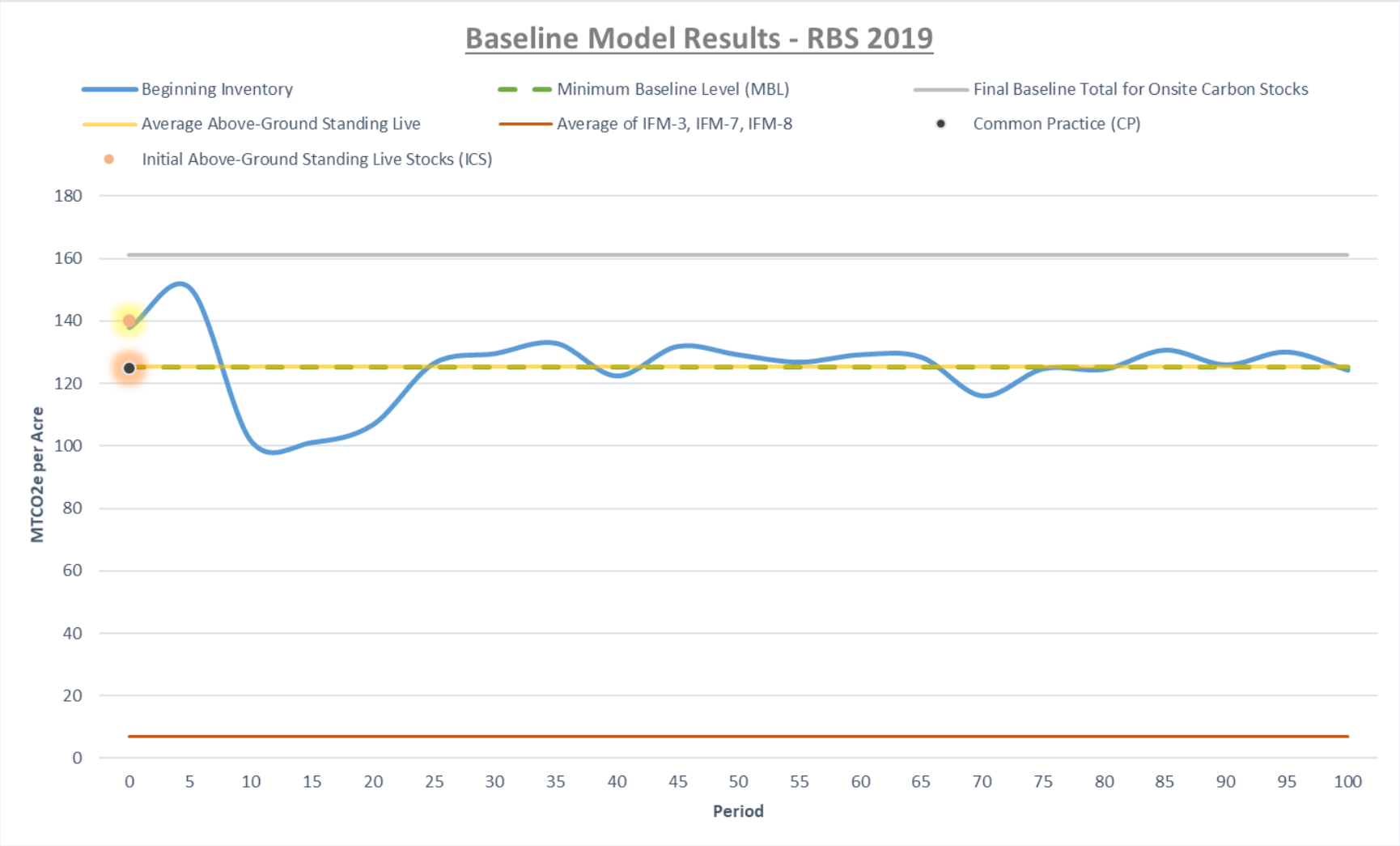


Figure 5 – Final Baseline Model

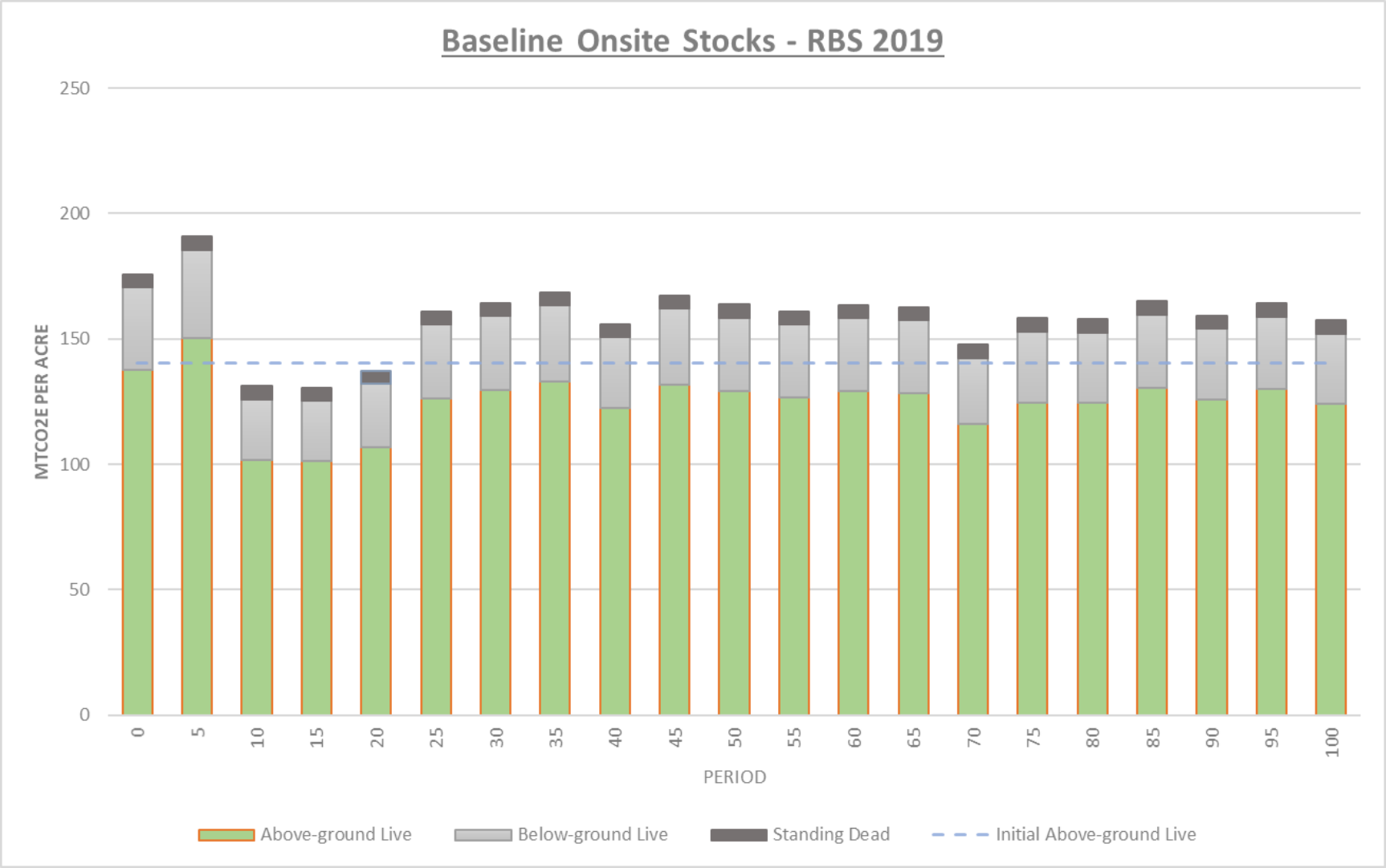


Figure 6 – Baseline Projected Onsite Stocks

7 – Project Carbon Stocks (IFM Private Lands)

a) Actual Onsite Carbon Stocks

Actual onsite carbon stocks were determined using 2020 inventory data (Refer to Section 5.e) and the most current volume and biomass equations for California (updated 09-19-2014). The initial condition tree list was grown forward one year to create the ending condition in March 2021. Plots were deemed static at the 2020 position for the initial reporting period as little to no growth occurs from October-April. A proprietary software program handles all equations and conversions using project tree inventory, plot, and stratum excel files. The program then exports an excel workbook that details the gross and net biomass and aggregates results at the plot and stratum level. Stratum values of $MTCO_2e$ are then summed and divided by their corresponding stratum acres to get the total $MTCO_2e$/acre for each carbon pool (Table 17 per Table A.3). Carbon pools for IFM-1 and IFM-3 are also stratified, so a summary of total carbon by carbon pool and stratum at the end of the reporting period was prepared per Table A.2 of the FOP (Table 18: IFM-1 and Table 19: IFM-3).

b) Actual Carbon in Harvested Wood Products

The values for actual carbon in harvested wood products is derived from depleting specific plots associated to the THPs in the project area for each reporting period and following equations found in Appendix C of the FOP. Tree frequencies prior to depletion are subtracted from their post depletion frequencies to calculate a harvest tree frequency. This harvest tree frequency is then used calculate the harvest metrics including total live biomass prior to mill delivery and sawlog volume (ft^3) by predominant harvested species (e.g. Ponderosa Pine, Sugar Pine, White Fir, Douglas Fir, Incense Cedar, and Other Conifers/Hardwoods) for the THP. Per equation C.10 of the FOP, actual carbon in standing live trees that would have been harvested and delivered to mills during the reporting period was calculated. The total volume of wood (ft^3) harvested in the reporting period for each species was multiplied by the wood density factors of the Pacific Southwest region and forest type based on harvest species per Smith et al. 2006, and then converted to metric tonnes of carbon multiplying by 0.5 and dividing by 2,204.6. Actual carbon transferred to wood products was then calculated by multiplying the carbon delivered to the mill by the appropriate regional mill efficacy percentages (0.568 for hardwoods and 0.675 for softwoods). Actual carbon transferred to in-use products by product class was determined per equation C.13 of the FOP by multiplying the wood product class percentages by carbon transferred to wood products. The amount of carbon transferred into each wood product was then multiplied by the 100-year average storage factor for In-Use Products (IFM-7) and Landfills (IFM-8).

Note: The estimated total harvest volume in the initial reporting period is 295,975 MTCO2e.

Table 17: Actual Onsite Carbon Stock Results by Carbon Pool

Carbon Pool	Source	Initial Data 15-Oct-2019 ($MTCO_2e$ per Acre)	End Data 31-Mar-2021 ($MTCO_2e$ per acre)
Standing Live Tree Above- and Below-ground Carbon Stocks (IFM-1)	Sampling results of live trees	**173.67**	**175.93**
Standing Dead Tree Above- and Below-ground Carbon Stocks (IFM-3)	Sampling results of dead trees	**5.08**	**4.96**
Shrubs and Herbaceous Understory Carbon (if required) (IFM-2)	NA	**NA**	**NA**
Soil Carbon (if required) (IFM-6)	NA	**NA**	**NA**
Sum of $MTCO_2e$ from Required Pools		**178.74**	**180.89**
Carbon in In-use Forest Products (IFM-7)	Harvest results from plot depletion	**NA**	**0.49**
Forest Product Carbon in Landfills (IFM-8)	Harvest results from plot depletion	**NA**	**0.32**
Biological Emissions from Decomposition of Forest Products (IFM-17)	NA	**NA**	**0.26**

Table 18: 2021 Summary of Standing Live (IFM-1) Stratified Carbon

Strata Name	No. of Plots	Carbon (CO_2/acre)			Acres	Carbon (CO_2) Total	Percentage Carbon (CO_2) Total
		Avg	Std. Dev.	Std. Error			
M_DF_150	1,474	166.0	118.0	3.1	6,015	998,776	6.8%
M_DF_175	1,487	205.3	126.3	3.3	6,089	1,250,048	8.5%
M_DF_200	1,544	238.1	144.0	3.7	6,219	1,480,672	10.0%
M_DF_225	1,412	263.4	149.2	4.0	5,931	1,561,937	10.6%
M_DF_275	1,445	317.6	170.4	4.5	5,887	1,869,584	12.7%
M_MC_200	1,608	250.4	152.0	3.8	6,429	1,609,636	10.9%
M_WF_150	1,526	162.9	113.8	2.9	6,153	1,002,351	6.8%
M_WF_175	1,312	208.4	128.6	3.6	5,288	1,102,317	7.5%
M_WF_200	1,663	239.4	136.1	3.3	6,647	1,591,557	10.8%
M_WF_250	1,326	287.9	157.9	4.3	5,384	1,550,093	10.5%
R_00	271	-	-	-	1,094	-	0.0%
R_05	934	-	-	-	3,779	-	0.0%
R_10	1,307	9.5	4.6	0.1	5,241	49,662	0.3%
R_15	1,314	18.2	12.6	0.3	5,292	96,104	0.7%
R_20	828	46.3	56.7	2.0	3,336	154,371	1.0%
R_25	625	55.5	40.7	1.6	2,487	138,090	0.9%
R_30	266	87.0	57.6	3.5	1,046	90,9992	0.6%
R_35	100	118.0	63.7	6.4	404	47,659	0.3%
R_40	295	141.2	75.4	4.4	1,164	164,439	1.1%
TOTAL	**20,737**	**-**	**-**	**-**	**83,886**	**14,755,199**	**100%**

Table 19: 2021 Summary of Standing Dead (IFM-3) Stratified Carbon

Strata Name	No. of Plots	Carbon (CO_2/acre)			Acres	Carbon (CO_2) Total	Percentage Carbon (CO_2) Total
		Avg	Std. Dev.	Std. Error			
M_DF_150	1,474	6.4	19.6	0.5	6,015	38,449	9.2%
M_DF_175	1,487	6.1	19.6	0.5	6,089	37,146	8.9%
M_DF_200	1,544	6.4	20.0	0.5	6,219	39,703	9.5%
M_DF_225	1,412	7.6	21.0	0.6	5,931	45,127	10.9%
M_DF_275	1,445	6.8	19.2	0.5	5,887	40,088	9.6%
M_MC_200	1,608	6.0	17.9	0.4	6,429	38,541	9.3%
M_WF_150	1,526	5.9	19.6	0.5	6,153	36,527	8.8%
M_WF_175	1,312	7.6	23.2	0.6	5,288	40,395	9.7%
M_WF_200	1,663	7.3	21.6	0.5	6,647	48,199	11.6%
M_WF_250	1,326	8.9	23.4	0.6	5,384	47,820	11.5%
R_00	271	-	-	-	1,094	-	0.0%
R_05	934	-	-	-	3,779	-	0.0%
R_10	1,307	-	-	-	5,241	-	0.0%
R_15	1,314	0.1	2.0	0.1	5,292	755	0.2%
R_20	828	0.3	2.0	0.1	3,336	930	0.2%
R_25	625	0.2	1.8	0.1	2,487	492	0.1%
R_30	266	0.6	3.1	0.2	1,046	595	0.1%
R_35	100	0.9	4.4	0.4	404	345	0.1%
R_40	295	0.6	6.6	0.4	1,164	711	0.2%
TOTAL	**20,737**	**-**	**-**	**-**	**83,886**	**415,821**	**100%**

c) Confidence Deduction

A confidence deduction is also applied to each year inventory data of actual carbon stocks if deemed necessary based on the stratified sampling error for the offset project. The biomass standard error (90% confidence) is a weighted SE% considering all stratums for the forest project. The SE% statistic is derived for each stratum using the below equation steps 1-7, and then weighted for the forest project using steps 8-11. The pooled stratum standard error is then multiplied by 1.645 to determine the sampling error at the 90% confidence level. The sampling error calculated out to **0.77%**, and therefore no confidence deduction was applied to the inventory data per Table A.4 of the FOP.

A_i	=	Stratum Acres
B_i	=	Stratum Biomass/Acre
SE_i	=	Stratum SE% (**decimal format**)
SE%	=	SE% for the Forest Project

$$\boldsymbol{SE\%} = \frac{\sqrt{\Sigma[((\boldsymbol{Ai} * \boldsymbol{Bi}) * \boldsymbol{SEi})^2]}}{\Sigma(\boldsymbol{Ai} * \boldsymbol{Bi})}$$

Stratum Standard Error Calculation

Step 1: Sum(Tree Biomass * Tree Freq) group by plot as "PlotSum"
Step 2: TotalSum = Total of all "PlotSum"
Step 3: TotalSumSquared = Total of All "PlotSum squared.
Step 4: Standard Diviation = Square Root of ((TotalSumSquared - (SquaredTotalSum / plot_Count)) / (plot_count - 1))
Step 5: StandardError = StandardDeviation / (Square root of plot_count)
Step 6: Mean = TotalSum / plot_count
Step 7: StandardError% = (StandardError / Mean) * 100

Forest Project

Weighted Forest Project's Standard Error is Calculate by:
Step 8: Stratum Biomass per Acre * Stratum Acres
Step 9: (Step 8 * (SE% / 100)) ^2
Step 10: Sum(Step 9)
Step 11: (SQRT(Step 10) / Sum(Step 8)) * 100

d) Quantifying Secondary Effects

Secondary effects can occur when a project reduces harvesting in the project area but increases harvesting on other regionally owned lands. This results in a negative value, as they increase GHG emissions caused by the offset project. Per equation 6.10 of the FOP, when average baseline harvested carbon exceed actual harvest for the reporting period, 20% of the difference between the actual and baseline carbon in harvested timber for the reporting period is calculated. When actual harvest exceeds baseline harvest, secondary effects is equal to zero. Secondary effects were automatically calculated using the "Confidential_RBS 2019_Calcs_Initial.xlsx – Final GHG Results" worksheet. Results were the following for the reporting period:

Secondary Effects ($MTCO_2e$)	**-63,940**

8 – Calculation of GHG Reductions and Removals

Total Net GHG Reductions and Removals were automatically calculated using the "Confidential_RBS 2019_Calcs_Initial.xlsx – Final GHG Results" worksheet following Equation 6.1. Results were the following for the initial reporting period:

Forest Buffer Account Contribution ($MTCO_2e$)	**296,817**
Total GHG Reductions and Removals ($MTCO_2e$)	**1,687,611**

Note: No confidence deduction was used in this project.

9 – Ensuring Permanence of Credited GHG Reductions and Removals

The ARB requires that credited GHG reductions and removals be effectively "permanent" for the offset project. For forest project's, this is met by ensuring that carbon credited remain stored for at least 100 years and by addressing the three mechanisms below.

a) Monitoring, Reporting and Verification

To meet the requirement of the FOP, the project operators will monitor onsite carbon stocks annually, submit regular monitoring reports and submit third-party verification of those reports along with periodic site visits as scheduled in the FOP for the duration of the offset project life.

b) Regulatory Obligation

The regulatory obligation for all intentional reversals of GHG reductions and removal enhancements will compensated through retirement of other compliance instruments.

c) Buffer Pool and Reversal Risk Rating

The maintenance of a buffer pool provides insurance against GHG reversals due to unavoidable risks. The offset projects reversal risk rating was determined on the potential for reversals associated with several types of risks and project-specific circumstances based on Appendix D of the FOP (Table 20). The total required buffer account contribution for the project was then calculated based on Equation D.1 of the FOP.

Table 20: Reversal Risks and Rating

Risk Category	Source	Contribution to Reversal Risk Rating
Financial Failure	Default Risk	5%
Illegal Forest Biomass Removal	Default Risk	0%
Conversion	Default Risk	2%
Over-harvesting	Default Risk	2%
Social	Default Risk	0%
Wildfire	Default Risk	4%
Disease or Insect Outbreak	Default Risk	3%
Other Catastrophic Event	Default Risk	3%

Reversal Risk Rating (**17.59%**) = 100% - ((100% - 5%)*(100% - 0%)*(100% - 2%)*(100% - 2%)*(100% - 0%)*(100% - 4%)*(100% - 3%)*(100% - 3%))

10 – OPO / APD Signature

Note: The person signing this Initial Reporting Period report should be the same person signing the accompanying U.S. Forest Offset Project Data Report Annual Reporting period. The date stated below is the date the OPDR was completed.

In signing this form, I certify under penalty of perjury under the laws of the State of California the GHG reductions and/or GHG removal enhancements for RBS 2019 from 15-Oct-2019 to 31-Mar-2021 are measured in accordance with the Compliance Offset Protocol – U.S. Forest Projects (Adopted: June 25, 2015) and all information required to be submitted to ARB in the Offset Project Data Report is true, accurate, and complete. I further certify that I am an Account Representative of the Offset Project Operator (OPO). I also attest that I am a California Registered Professional Forester (RPF# 2066) and I have overseen the development of this project.

Signature: Date:

X Edward C Murphy 02-Jun-2022

Edward Murphy
Manager of Resource Inventory Systems

References

Biging, G.S., and L.C. Wensel (1984) **Site index equations for young-growth mixed conifers of Northern California**. Research Note No. 8. Northern California Forest Yield Cooperative, Department of Forestry and Resource Management, University of California, Berkeley.

CA Air Resources Board (2015) **Compliance Offset Protocol U.S. Forest Offset Projects – U.S. Forest Projects**. https://ww2.arb.ca.gov/sites/default/files/cap-and-trade/protocols/usforest/forestprotocol2015.pdf

California Coastal Conservancy, U.S. Fish and Wildlife Service (FWS), and California Department of Fish and Wildlife (CDFW) (2019) **Passage Assessment Database**. September 2019 Version.

California Department of Forestry and Fire Protection (CAL FIRE) Resource Management, Forest Practice Program (2019) **California Forest Practice Rules 2019**. Title 14, California Code of Regulations Chapters 4, 4.5, and 10.

Cairns, M.A., S. Brown, E.H. Helmer, and G.A. Baumgardner (1997) **Root biomass allocation in the world's upland forest.** Oecologia 111: 1-11.

Climate Action Reserve (2014) **Quantification guidance for use with Forest Offset Projects**. http://www.climateactionreserve.org/how/protocols/forest/dev/version-3-3/

Harmon, M.W., C.W. Woodall, B. Fasth, J. Sexton, and M. Yatkov (2011) **Differences between standing and downed tree wood density reduction factors: a comparison across decay classes and tree species.** Research Paper NRS-15. U.S. Department of Agriculture, Forest Service, Northern Research Station.

Hui, G.Y., and K.V. Gadow (1993) **Zur Entwicklung von Einheitshöhenkurven am Beispiel der Baumart Cunninghamia lanceolata**. Allgemeine Forst-und Jagdzeitung 164(12): 218-220.

Krumland, B., and H. Eng (2005) **Site index systems for major young-growth forest and woodland species in Northern California**. California Forestry Report No. 4, April 2005.

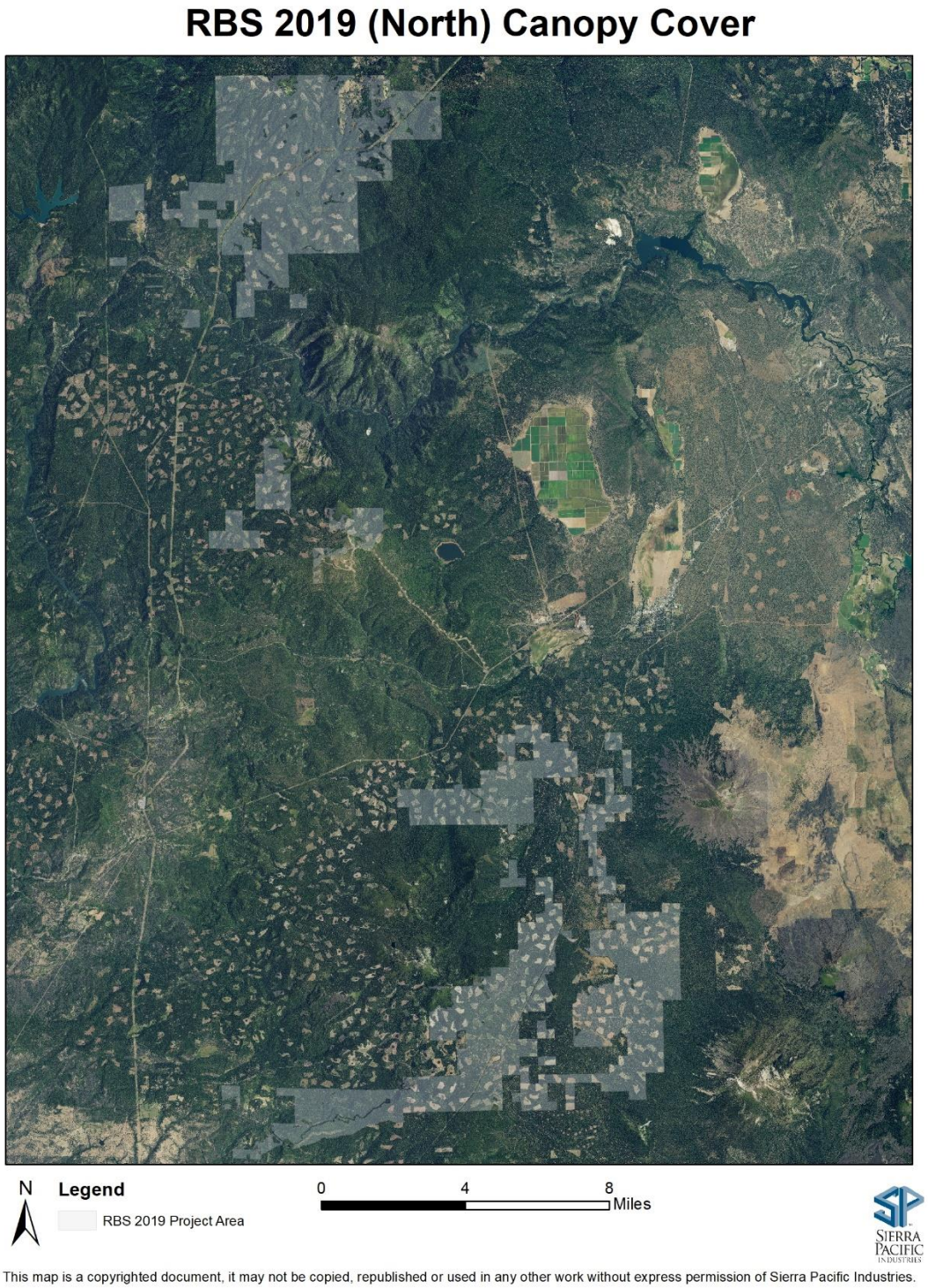
Smith, J.E., L.S. Heath, K.E. Skog, and R.A. Birdsey (2006) **Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States**. General Technical Report NE-343. U.S. Department of Agriculture, Forest Service, Northeastern Research Station.

Welsh H.H., Jr (1994) **Bioregions: an ecological and ecological perspective and a proposal for California**. California Fish and Game 80: 97-124.

Wensel L.C.., P.J. Daugherty, and W.J. Meerschaer (1986) **Bulletin 1920: CACTOS user's guide: the California conifer timber output simulator**. Division of Agricultural Sciences, University of California, Berkeley.

Appendices

Appendix A – Project area is on lands greater than 10% canopy cover



RBS 2019 (South) Canopy Cover

N

Legend

RBS 2019 Project Area

0 2 4 Miles

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Appendix B – Legal Constraints

Legal Constraint and Applicable Agency	Geographic Range	Forest Management Effect	Modeling Techniques to Simulate the Constraint
Watercourse and Lake Protection Zones (California Forest Practice Rules -Article 6, CAL FIRE & CDFW)	WLPZ units within the project area.	Higher retention of trees and canopy cover adjacent to watercourses to ensure water quality, protection of riparian and aquatic habitat, and erosion prevention.	Streams were buffered based on their class and restrictions if they were in an evolutionary significant unit (ESU) watershed. All WLPZ buffers were conservative as they exceeded Forest Practice Rules requirements. WLPZ units were assigned a light selection harvest every 5-years and were cut to maintain a target basal area of 120 ft^2. If the WLPZ unit was identified as having ESU constraints, canopy cover of 75% or greater was also maintained.
Stocking Standards (California Forest Practice Rules – Article 3, CAL FIRE)	All units with associated silviculture in the project area.	Maintain forest structure and diversity following various harvest prescriptions.	Modeled silviculture consistent with Forest Practice Act to ensure stocking standards were maintained based on silviculture method and site class.
Adjacency Requirements (California Forest Practice Rules, CAL FIRE)	Evenaged regeneration units	Reduce the area impacted by evenage silviculture and to maintain greater forest cover.	Evenage units were restricted so that no unit could be harvested adjacent to another for 10-years or greater.