OFFICIAL RESPONSE
OF THE DIRECTOR OF THE CALIFORNIA
DEPARTMENT OF FORESTRY AND FIRE PROTECTION
TO ENVIRONMENTAL ISSUES RAISED DURING
THE TIMBER HARVESTING PLAN EVALUATION PROCESS

THP Number	4-08-024/AMA-1
County	Amador
Submitter	Sierra Pacific Industries
Location	Sections 1,2,12,13;T7N;R13E & Secs. 6,7;T7N;R14E & Sec. 36;T8N;R13E, MDM&B
Acres	522 Logging Acres
Silvicultural Methods	Selection, Fuelbreak, Clearcutting
End of Public Comment Period	May 1, 2009
Date of Approval and Response	May 15, 2009

The California Department of Forestry and Fire Protection (CDF, CAL FIRE) prepared the following response to issues raised during the review and evaluation of the above referenced Timber Harvesting Plan (THP) in conformance with 14 CCR Sec. 1037.4. The regulations say that CAL FIRE is to consider all written comments and respond in writing to issues raised. In the attached Official Response, comments made on similar topics are grouped together and addressed as a single issue. Remarks concerning the validity of the review process, questions of law, or topics so remote or speculative that they cannot be reasonably assessed were considered by CAL FIRE, but are not addressed in writing, as they are not considered to be issues concerning the particular THP project that is the subject of this Official Response.

Subsequent to the September 4, 2008 submittal of the THP, information and changes which could be considered significant were added to the respective plan's record. In accordance with the California Environmental Quality Act (CEQA) §21092.1, and Guidelines 14CCR §15088.5; and the Forest Practice Act PRC §4582.7, and Rules 14 CCR §§ 898.1(d) and 1037.4, the public comment period for the THP was extended for 30 days.

Sincerely,

Michael J. Bacca

Michael J. Bacca
Forester II, Forest Practice Manager
RPF # 2236

STAFF FORESTER: DeBenedet
cc: Amador El Dorado Unit
Amador County Planning
California Department of Fish and Game
California Department of Parks and Recreation
Central Valley Regional Water Quality Control Board
California Geological Survey
Center for Biological Diversity

OFFICIAL RESPONSE
TIMBER HARVEST PLAN #4-08-024/AMA-1

NOTIFICATION PROCESS

To inform the public of this proposed Timber Harvesting Plan (THP) and determine if there were any concerns with the plan the following actions were taken:

- Notice of the receipt of the plan was submitted to the county clerk for posting with other environmental notices (ref. 14CCR §1032.8).
- Notice of the plan was posted at the Department's local office and also at the regional office in Fresno. (ref. 14CCR §1032.8).
- Notice of the receipt of the THP was sent to those organizations and individuals on the Department's list for notification of plans (ref. 14CCR §1032.9(b)).
- A "Notice of the Intent to Harvest Timber" was posted near the plan site (ref. 14CCR §1032.7).
- A "Notice of Intent to Harvest Timber" was mailed to all property owners within 300 ft. of the plan boundary, where applicable (ref. 14CCR §§1032.7(e) & (f)).

In addition, the Department determined that a pre-harvest inspection (PHI) was required to take place on the site of the proposed operation before a decision could be made on the proposed plan. The review of this plan resulted in site-specific measures being incorporated into the THP. With the addition of these protective measures CAL FIRE determined there would be no significant adverse or cumulative impacts resulting from this plan.

PUBLIC REVIEW AND COMMENT

As part of the review process, the THP and other documents are available for public review and comment. THPs are available from the CAL FIRE Regional Office in Fresno CA; and, at the CAL FIRE Unit Office in Camino, CA. THPs can be reviewed free of charge at these offices, however there is a charge for removing copies from the CAL FIRE office. The cost depends on the THP's size.

Review Team meetings occur in Fresno and, insofar as possible without disrupting the work of the team, the public may attend. The chairperson of the Review Team may impose limitations on the scope of any public participation or the number of persons who attend the meetings in the event space is limited. 14 CCR Sec. 1037.5(d). The meetings are not public hearings, however if any public is interested in attending, they can contact CAL FIRE in Fresno to obtain the time and place of the Review Team meetings.

Subsequent to the submittal of the THP, information and changes which could be considered significant were added to the respective plan's record. In accordance with the California Environmental Quality Act (CEQA) §21092.1, and Guidelines 14CCR §15088.5; and the Forest Practice Act PRC §4582.7, and Rules 14 CCR §§ 898.1(d) and 1037.4, the public comment period for the THP was extended for 30 days.

THE THP REVIEW PROCESS

GENERAL LAWS AND REGULATIONS

Statute law governs the THP review process. These laws include, but are not limited to, the Z'berg-Nejedly Forest Practice Act (FPA) Division 4, Chapter 8, California Public Resources Code (PRC), Sections (4511-- 4628) of 1973, Timberland Productivity Act of 1982, California Environmental Quality Act (CEQA) of 1970, Porter Cologne Water Quality Act, and various laws that are concerned with protection of rare, threatened or endangered species. The State Board of Forestry and Fire Protection (BOF) determine administrative rules found in the California Code of Regulations (CCR) based on the authority granted to the BOF by the legislature as found in the Public Resources Code. One of the founding principles of the PRC as adopted by the legislature is found in PRC Sec. 4513, titled INTENT OF LEGISLATURE, as follows; "*It is the intent of the Legislature to create and maintain an effective and comprehensive system of regulation and use of all timberlands so as to assure that: (a) Where feasible, the productivity of timberlands is restored, enhanced and maintained. (b) The goal of maximum sustained production of high-quality timber products is achieved while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment, and aesthetic enjoyment.*" The CCR's purpose is to implement these laws (14 CCR 896).

The Board of Forestry and Fire Protection intended the CCRs to provide an exhaustive set of criteria for reviewing THPs. The CCR serves as detailed, explicit instructions regarding permissible and prohibited actions of on-the-ground harvest operations. Some major Articles included in the CCRs are:

Article 3. Silvicultural Methods
Article 4. Harvesting Practices and Erosion Control
Article 5. Site Preparation
Article 6. Water Course and Lake Protection
Article 7. Hazard Reduction
Article 9. Wildlife Protection Practices
Article 12. Logging Roads and Landings
Article 14. Archeological and Historical Resource Protection

THE MULTI-DISCIPLINARY REVIEW

A THP is prepared by a Registered Professional Forester (RPF) who is licensed by the State after passing education requirements and exams. CAL FIRE, which is a public agency having numerous RPFs on staff, independently reviews a submitted THP by using a multi-disciplinary Review Team. This team normally consists of, but is not limited to, representatives of CAL FIRE (team leader), the Department of Fish and Game (DFG), the Regional Water Quality Control Board (WQ),the California Geological Survey (CGS)), an Archaeologist (CAL FIRE), and a representative of county government when the county so requests. CAL FIRE can call

upon other expertise to assist in review including, but not limited to, hydrologists, soil scientists, federal agencies, fire experts, tribal groups, and many others.

The Review Team meets when the THP is first received to make a preliminary determination regarding the THP's conformance to the CCRs. The team then may recommend a site-specific preharvest inspection (PHI) to determine whether the THP accurately describes ground conditions, whether the measures proposed are appropriate, and whether additional mitigation measures are necessary. Team members may attend the PHI, which is usually conducted by a local CAL FIRE Area Forester assigned to one of the Ranger Units in a particular county, and CAL FIRE may request attendance by other experts and agency personnel. The PHI often results in additional mitigation measures to better insure environmental protection. A second Review Team Meeting is convened to look at the report from the local CAL FIRE Area Forester, examine any public comment or comment from concerned agencies and determine whether the THP should be approved as written, approved with extra mitigation measures, or denied. Letters and copies of PHI reports may be sent out to the RPF who prepared the THP with a number of recommendations that the Review Team members find are necessary to bring the THP into conformance with the law and lessen any potential for environmental impacts.

For THP 4-08-024/AMA-1, the plan was first received on September 4, 2008 and was found acceptable for filing on September 12, 2008. The Review Team ordered a PHI to occur. The PHI occurred on September 23, 2008. Present on the PHI from CAL FIRE were Forest Practice Inspector Phyllis Banducci and Bill Solinsky, Review Team Chair. From SPI were Daniel DeArmond and Ed Struffenneggar. Mark Stewart, RPF, was present from EBMUD. Also present were Chris Cochrane of RWQCB, Rianna Lee and Tim Nosal, DFG, and Geologist Bill Short of CGS. The PHI was closed on September 23, 2008.

The Review Team met for the second review of the THP, following the PHI. Second review was to review the THP with revisions, PHI report, and to consider the public comments that had been received. The Review Team examined mitigation measures already submitted in order to insure that the revised plan was in conformance with the CCR and to insure that environmental concerns were addressed in order that no potential for significant adverse environmental impacts would be likely to occur from the timber harvest operation and associated activities. When the plan was deemed complete by the Review Team Chair, it was recirculated to the Review Team and to those members of the Public who had commented on the plan.

TIMBER HARVEST AND STOCKING COMPLIANCE

Timber harvest may start after THP approval and continue for up to three years. CAL FIRE grants extensions under special circumstances for up to two more years, for a total of five years. The THP submitter must notify CAL FIRE before starting harvest operations.

CAL FIRE inspects the harvest operation for CCR compliance, although the number and frequency depends on the size, duration, complexity, regeneration method, and potential for adverse impacts. The THP and CCRs provide the criteria that CAL FIRE uses to determine compliance. CAL FIRE's policy is to vigorously pursue the prompt and positive enforcement of the FPA, CCRs, and related laws and regulations applying to timber operations on non-federal lands in California. The policy's intent is to prevent forest practice violations, and achieve prompt corrective action if violations do occur. The FPA, CCRs, and other related laws and regulations are enforced, include issuing violation notices, imposing civil penalties and pursuing criminal court proceedings.

Licensed Timber Operator (LTO) and Registered Professional Forester (RPF) licensing actions may also be pursued. Most forest practice violations are correctable, and CAL FIRE insures they are corrected. Non-correctable violations that result in harm to the environment often result in criminal court actions against the offender. Normally some sort of correction work is required to help offset non-correctable adverse impacts when the offender is found guilty.

A THP Completion Report must be submitted certifying that the area meets CCR requirements. CAL FIRE inspects completed work to insure compliance with the CCRs. Stocking standards are to be met immediately following completion of the timber operations for some silvicultural methods or may be required five years after completion of timber operations where methods are used that require artificial or natural regeneration to successfully occur so that the area is restocked with seedlings.

THP PROPOSED ACTIONS

The following is a summary of some of the contents and objectives from THP 4-08-024/AMA-1. This summary is not intended to replace anything that is actually found in the THP as approved and is merely provided for the convenience of the public who has submitted written comments. An actual copy of the approved THP may be obtained for a fee by writing to CAL FIRE, Resource Management, 1234 E. Shaw Ave, Fresno, CA, 93710. Some of the rules and regulations are also summarized in this document in order to provide the reader with an understanding of their content and restrictions. However, a copy of the entire rule book can be purchased from CAL FIRE, or is available for review for free on the Internet site http://www.fire.ca.gov/resource_mgt/resource_mgt_forestpractice.php. Look under the title "Forest Practice more Info..." for titles "Forest Practice Act" and "Forest Practice Rules".

GENERAL DESCRIPTION OF THE THP

The THP totals a net 522 logging acres located in 1,2,12,13;T7N;R13E & Secs. 6,7;T7N;R14E & Sec. 36;T8N;R13E, MDM&B in Amador County. The plan area is located at an elevation ranging from 3,100' to approximately 4,200', and is located in the Mill Creek Planning Watershed, which contains tributaries to the North Fork of the Mokelumne River. Slopes are moderate to steep within the logging units. The project actually can be said to consist of some 11 individual even-age regeneration units along with a scattering of Selection logging and a large area of Fuelbreak logging. The units are generally separated by extensive areas that have largely been logged selectively in the past, largely by Georgia-Pacific and American Forest Products and other private industrial timberland companies. There are scattered areas that were burned in wildland fires of the past.

The watershed assessment area is described in the plan as being 8,206 acres of the Mill Creek Planning Watershed, while the biological assessment area include all of the Mill Creek Planning Watershed and also extends to one mile beyond unit boundaries and is just over 9,000 acres. Within the watershed area, SPI owns about 72% of the land and the federal government owns 5%. Small private landowners make up the remainder. However, for biological resource assessment area, there is a higher proportion of federal land. The biological assessment area is appropriately larger,. The fact that some animal species have a pattern of migration over larger areas, and areas not bounded by the watershed assessment area was considered.

The USFS had a 40 acre thinning project in the watershed assessment area in 2001 to enhance habitat wildlife. The USFS does not have known activities planned in the coming 5 years in the watershed assessment, but any activities would likely include understory thinning and fire hazard reduction type projects. SPI does not report any definitive probable future logging plans within the watershed for the decade long planning horizon, but does show a tentative logging plan for the area which includes several plans just to the south and north of the current planning watershed. CAL FIRE assumes that private industrial timberland would be likely to have at the very least some type of salvage logging events to capture mortality on an on-going basis within the watershed.

Maps were included in THP section IV that showed the location and silvicultural methods of past logging events on SPI lands within the watershed assessment area. Several past projects are contemporary with the current project, including THP 4-02-10/AMA, THP 4-99-42/AMA, THP 4-01-26/AMA & THP 4-02-70/AMA.

Possible cumulative effects are analyzed in the THP. CAL FIRE found that the discussion is in compliance with the intent of the BOF regulations. The previous private industrial landowners were Georgia-Pacific West, Georgia-Pacific Corporation, American Forest Products, Bendix Corporation and other subsidiaries of these companies who tended to use primarily single tree selection. As reported in the THP, these decades of removal of the best and largest trees from the forest component have resulted in a slower growing forest which is not achieving the landowner's desired productivity objectives. Where the previous individual tree selection methods were extensively used for decades upon decades, trees that are currently in the overstory of these logged lands were actually understory or slowly growing trees at a previous time. Species composition in some of these frequently logged areas tend towards fir and cedar species as pine was repeatedly removed due to the higher values and lower ability to reseed under the forest canopy. Thus, the current landowners have seen a need to use even-aged regeneration methods to remove the current stand and replace it with faster growing planted seedlings of a more desirable and historic species composition. CAL FIRE assumes that some additional entries are possible within a five year period, consistent with the rules of the BOF. Recent changes in federal land management make it possible to make an assumption that logging which is designed to reduce the potential for fire hazardous conditions or manage roadside fuelbreaks or to provide for better habitat for California spotted owl is also possible on USFS lands.

In addition to this watershed area, CAL FIRE also took into consideration known activities that have occurred in assessment areas other than the Mill Creek Planning Watershed where there could be a potential for impacts to combine to create significant adverse individual or cumulative effects in the general vicinity of the THP area. CAL FIRE maintains a Geographical Information System to document the location and silvicultural methods of past and present projects. The CAL FIRE Forest Practice Inspector considered projects inside and outside the immediate THP location to determine that the project would not contribute to significant adverse direct or cumulative environmental impacts.

SILVICULTURAL METHODS

Silvicultural Methods are listed in the CCR as various harvesting methods that can be chosen by the RPF in order to generate forest products and insure that the timber stand can be perpetuated over time so that forest values will be protected and future harvests will be possible. The CCR requires the RPF to select systems and alternatives that achieve maximum sustained production of high quality timber products (14 CCR Sec. 953) and to meet the objectives of the Forest Practice Act (PRC 4512 & 4513).

This project proposes harvesting distinct and separated relatively small areas using the even-age regeneration method of clearcutting and others using the uneven-age selection method. Selection is being prescribed within the Watercourse and Lake Protection Zones (WLPZ) of Class I and Class II watercourses. Where this method is being used, stocking will be met with at least 100 sq. ft. of BA on Site I lands and the residual stand shall contain 15 sq. ft. of BA of trees which are 18" dbh or greater. The total amount of selection silviculture in the plan is 26 acres.

The Fuelbreak method is being used on 290 acres of the plan. The purpose is to achieve a desired tree spacing of 20 feet between leave trees. The stand will be harvested using mechanized whole tree yarding systems. In addition to spacing, the stand will be thinned from below. Anticipated stocking will be in the range of 60 to 90 sq. ft. per acre in order to adequately limit interlocking crowns and ladder fuels to prevent the spread of any wildfire that may occur in the vicinity of the project in future years.

A smaller area of the plan consists of 11 units of even-age regeneration using the Clearcutting silvicultural method. There will be 172 acres treated with this method in units that are generally less than 20 acres in size, although one unit is 23 acres as justified in the THP in accordance with the size exceptions allowed in the rules of the BOF. All units were observed to be greater than the spacing limits required in the rules of the BOF. Post harvest stocking will be accomplished by 300 point count of planted seedlings per acre and the post harvest stocking species composition is expected to closely resemble the pre-harvest species composition. These even-age areas will be site prepped prior to planting. Herbicides are typically used by SPI to insure successful regeneration of the even-aged regeneration units and potential known impacts of these products were considered by CAL FIRE in analyzing this project.

Considering previously approved THPs and considering known probable future projects for the immediate area of the current THP, the area will have an assortment of various types of treatment including areas of Selection logging, areas that have been thinned, non-commercial and wet areas, and extensive areas that have not recently been logged within the assessment area.

A ten year re-entry period has been fairly typical for central Sierra industrial timberlands where uneven-age silvicultural methods were previously used. Under the current THP, even-age regeneration units will be replanted using artificial methods to insure that the areas will meet the requirements of 300 seedlings per acre alive and healthy within 5 years following the completion of timber operations. Consequently, re-entry periods in these areas will be expected to be significantly longer than where even-age operations have replaced the previous use of uneven-age methods. Typical re-entry periods where even-age management is used range from 50 to 80 years.

HARVESTING PRACTICES AND EROSION CONTROL

The CCR states that timber operations shall be conducted to: meet the goal of maximum sustained production of high quality timber products; minimize breakage of merchantable timber; prevent unreasonable damage to residual trees, fish and wildlife habitat as identified in the THP, or contained in the rules, reproduction, and riparian vegetation; prevent degradation of the quality and beneficial uses of water; and maintain site productivity by minimizing soil loss. (14 CCR Sec. 954)

For this THP, the Plan Submitter proposes to harvest 522 net acres of conifer sawlogs, fiberlogs, biomass, and fuelwood with the approval of this THP. The proposed harvest method will be by ground based tractor, rubber tired skidder and feller/buncher equipment, but there are also units that will utilize ground lead, high lead, and skyline cable yarding. The Erosion Hazard Rating for the area in the submitted plan was listed as Moderate and High. The THP indicated no unstable areas. The THP area was examined in the field by a CGS geologist to confirm these findings.

The THP contains provisions for operating during the winter months. Winter operating restrictions include a provision that ground based operations could occur during dry rainless periods where soils are not saturated. Winter operations will not occur in WLPZ areas. Waterbar spacing will be done to the High Erosion Hazard Rating spacing in the winter. Tractor roads shall not be constructed during the winter except in dry, rainless periods. Erosion control structures would be installed on all constructed tractor roads and seasonal truck roads prior to the end of the day if the US Weather Service forecasts a chance of rain the following day, and prior to the weekend or other shut down periods. Timber operations would be allowed to occur during dry cold weather or during dry rainless periods when soils are not saturated.

CAL FIRE has noted that past SPI THPs with winter logging provisions were typically only active during the early winter period before substantial rainfall has occurred and again late in the spring during years when the rainfall stopped and conditions had dried out substantially in the field.

SITE PREPARATION

The CCR states that site preparation shall be planned and conducted in a manner that encourages maximum timber productivity, minimizes fire hazards, prevents substantial adverse effects to soil resources and to fish and wildlife habitat, and prevents degradation of the quality and beneficial uses of water. (14 CCR Sec. 955)

Site preparation and planting will be needed in the harvested areas where the Clearcutting Prescription is being used. Mechanical site prep will be done using tractors, but track excavators may be used on steeper slopes. Mechanical site prep will not occur in WLPZs or ELZs, but an exception was approved for excavators reaching into these areas to pile slash. The objective of mechanical site prep is to leave as much organic material as possible while providing planting locations and fire protection. A mix of tree species will be used to reforest the area and it is assumed that herbicides will be used to promote the growth of conifer seedlings in deference to competition for water, sunlight and nutrients from brush or grass species.

While no actual direct prescription for herbicide use was contained in the THP, CAL FIRE has extensively considered the potential for herbicide use from among the most commonly used products that have been approved for such reforestation use by State and Federal agencies. There are only a limited number of registered products that are used for vegetation management on these types of forested lands and CAL FIRE is aware of the type of products that have been prescribed by SPI in the past. (see, for example, the Official Response to Public Comments on the recently approved THP 4-07-37/TUO-6) These registered products were considered by CAL FIRE in analyzing the potential impacts of this project and are also analyzed in the current THP that was available for public comment.

WATERCOURSE AND LAKE PROTECTION

A purpose of the CCR, with respect to watercourse and lake protection, is to insure the protection of beneficial uses that are derived from the physical form, water quality, and biological characteristics of watercourses and lakes. The BOF has stated its intent that the productivity of timberland be maintained, restored and enhanced while providing equal consideration for the beneficial uses of water. (14 CCR Sec. 956)

For this THP, there are Class I, Class II and III watercourses present within the THP that must be protected from timber operations. Class I watercourses, which include Antelope Creek, Mill Creek and Little Mill Creek, will be protected by a WLPZ that ranges in size from 75' to 150' on either side of the watercourse. There are five Class II watercourses or segments that will be protected by a Watercourse and Lake Protection Zone which varies from 50 to 100 feet in width. There are 8 Class III watercourses or segments that will be protected by an Equipment Limitation Zone of 25' or 50' wide depending on the steepness of the slopes, except for planned skid crossings of the watercourses.

New waterhole construction is anticipated and standard measures recommended by DFG were included in the THP. An in-lieu watercourse practice was proposed and approved, which includes use of an existing landing within the ELZ of a Class III watercourse. The THP contains numerous measures to improve drainage facilities.

DFG regulations require submission of a 1611 stream alteration permit that must be approved prior to timber operations that change or alter watercourse protections.

The BOF methodology of determining cumulative watershed impacts was utilized in preparation of this THP. The conditions of streams as shown in the THP are mixed from fair to good. Reasons given for fair rating include an especially high storm-flow condition from the winter of 1997. This plan contains mitigations to resolve problems and reduce the potential for future impacts to the quality and beneficial uses of water. Without approval of this THP, there would be no regulatory authority in place that would require maintenance of roads as these requirements have largely expired on previously logged THPs in the assessment area.

HAZARD REDUCTION

It is the intent of the BOF to provide standards for the treatment of snags and logging slash to reduce fire and pest hazards on the logging area and to protect the area from potential insect and disease problems and to do this while retaining wildlife habitat. (14 CCR Sec. 957)

This particular THP does not have roads that will require treatment of logging slash near the roadways as there is no general public access through the area. Slash will, however, be treated in the Fire Hazard Protection Zone which involves a permanent structure maintained for human habitation. Slash piles resulting from whole tree harvesting may have delayed treatment. Any delay in treatment will require a notification to CAL FIRE along with a map showing the location of these untreated piles. Slash treatment is anticipated for the remainder of the project area where the Clearcut Prescription is being used. While most slash piles will be burned, an occasional pile may be left for wildlife purposes. The area of the plan that is proposed as Fuelbreak silviculture has the intent "to eliminate and/or reduce the vertical and horizontal fuel continuity that promotes the spread of wildfire. This will be accomplished by treating the vegetation through whole tree yarding, which means taking the top of the trees and as much of the limb material as possible to the landing for processing. Another goal will be to harvest the suppressed sub-merchantable understory trees, often described as ladder fuels."(pg 42)

Some reduction in the overall fire hazard of the area can be anticipated due to Fuelbreak silviculture, the even-age methods being used, opening and maintenance of roads, and creation of skid trails that would tend to provide a bare mineral soil break in fuel types. Over time, the reduction of fire hazard will tend to dissipate as the forest grows back and skid trails become covered with pine needles, seedlings and new vegetation. Eventually, as the evenaged structures develop, they will become less likely to be damaged by ground fires and less likely to provide fuel ladders and conditions that would lead to crown fire, than the stands they are replacing.

WILDLIFE PROTECTION

The regulations state that timber operations shall be planned and conducted to maintain suitable habitat for wildlife species. (14 CCR Sec. 959).

This THP examines the potential impact of the logging on wildlife and plants and finds that there is a potential for rare, threatened or endangered plant and animal species to occur in an area impacted by the timber operation. These findings resulted from a scoping check of the Natural Diversity Database, the DFG Rarefind program, the California Wildlife Habitat Relationship program, the SPI database of known locations for sensitive species, and discussions with the USFS. Actual location of some sensitive species was confirmed prior to plan submittal and the plan also listed protection and consultation measures to be initiated in the event that surveys done prior to the start of actual timber operations discover any sensitive species.

There are about 3 previously known locations of California Spotted Owls occur in the assessment area and one in proximity to the THP as noted in the plan. Additional surveys will be conducted prior to the start of timber operations. Current SPI policy is to insure a ¼ mile buffer from an occupied nest until wildlife retention trees can be designated by a wildlife biologist where no logging or road building will occur between March 15 and August 15 of any year. It is noted that the California Spotted Owl does not currently have a status in the Forest Practice Rules as a listed species nor is there any specific regulations that pertain to the species.

CAL FIRE has been treating the owl with special concern when they are known to exist near a project area. In general, harvesting could potentially have the effect of increasing the prey base for the California spotted owl by creating more habitat for some of its prey species, especially small mammals such as mice and pocket gophers. Where there is adequate nesting and roosting habitat, increasing the prey base generally enhances owl viability.

Within the biological assessment area, there are no previously known locations of Northern Goshawk. DFG consultation would be required in the event that a Northern Goshawk was discovered and the rules of the BOF prescribe a protection area.

Amphibian surveys for the project area yielded no locations of Red-legged frog, western pond turtle (not an amphibian, but residing in the same habitat), mountain yellow-legged frog or foothill yellow-legged frog on the project area and there is no previously recorded presence of the species within the assessment area itself. Foothill and mountain yellow-legged frog are not listed species, but consideration species of special concern by the State. WLPZ protections for watercourses would likely provide some protection for these mentioned amphibian species if any were present. Western pond turtle was not sighted during THP preparations, but again, WLPZ protections should offer habitat protection for the species if any are present. Yosemite toad was recently identified by the USFWS as a potential species of federal concern, although the species was not listed at the present time do to inadequate staffing. In 2002 the FWS said: "The Yosemite toad is a high-elevation species found in the central Sierra Nevada mountains. The current range of the Yosemite toad extends from Ebbetts Pass in Alpine County to south of Kaiser Pass and Evolution Lake, Fresno County. The Yosemite toad commonly occurs at elevations between 8,000 and 10,000 feet. In making this finding, the Service recognizes that there may have been declines in the distribution and abundance of Yosemite toads. The best available evidence indicates that some toad populations have declined by at least 50 percent from historical levels. These declines are primarily attributed to habitat degradation, airborne

contaminants and drought. Declines in Yosemite toad populations have occurred in Yosemite National Park, the heart of the species' range, and throughout the Sierra Nevada. More than 90 percent of Yosemite toad habitat occurs within U.S. Forest Service wilderness areas and on National Park Service lands. The Forest Service has proposed several standards and guidelines to protect and enhance the Yosemite toad and its habitat. One of these guidelines is to develop and implement a conservation strategy for the Yosemite toad with the Service. The Forest Service believes it can take measures to improve Yosemite toad habitat through better management of livestock grazing and fish stocking on lands that it manages." Information updated to March of 2008 the FWS says: "LAND OWNERSHIP: The vast majority of land within the range of the Yosemite toad is federally managed, with 919,011 ha (2,270,918 ac) (99 percent of the range) on USFS, NPS, and BLM lands. Much of this land is within designated wilderness. The remaining land within the species' range is a mix of State, local government, and private lands." Given the species range and elevation and landownership pattern there is little likelihood that this THP will impact this species.

CAL FIRE reviewed a recently published report by the Environmental Protection Agency (EPA) titled: "Effects Determination for Atrazine and the California red-legged frog and the Delta Smelt", as well as similar published reports for the chemical pesticides Glyposate, Hexazinone and Imazapyr. Also reviewed were the Effects Memorandum letter and the Transmittal Letter for each pesticide. These reports were compiled over the past three years, but have recently been released in composite at the website http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog. The effects of the various products were found to differ from no direct effect to CRLF to indirect effects to CRLF habitat. The information in the publication was specific to CRLF and it was unknown if the same effects would have been found if the target species was one of the other amphibian species. For THP 4-08-024/AMA-1 however, CRLF is not known to be currently found within either the watershed assessment area or the biological assessment area of the project. From the report is a summary of the habitat requirements for the species as follows: "*Most CRLF populations have been documented below 1,050 m, although there are some historical sightings documented up to 1,500 m. CRLFs require aquatic habitat for breeding, but also use other habitat types, including riparian and upland areas, throughout their life cycle. CRLF use of their environment varies; they may complete their entire life cycle in a particular habitat or they may utilize multiple habitat types. Overall, populations are most likely to exist where multiple breeding areas are embedded within varying habitats used for dispersal (USFWS 2002). Generally, CRLFs utilize habitat with perennial or near-perennial water (Jennings et al. 1997), and dense vegetation close to water and shading water of moderate depth are habitat features that appear especially important for CRLF (Hayes and Jennings 1988).*
Hayes and Jennings (1988) recorded occurrences from two sites in California, and found that CRLFs were primarily located in aquatic habitats with intermittent streams, which included some area with water at least 0.7 meters deep, had emergent or shoreline vegetation, and lacked introduced bullfrogs. Emergent vegetation consisted mainly of cattails (Typha spp.) and tules (Scirpus spp.), while shoreline vegetation was primarily composed of willows (Salix spp.). They report more findings of CRLFs at sites with native fish than those with introduced fish species. CRLFs were also more frequently recorded at sites influenced by a small drainage area (< 40 km^2), having a low slope, and with low-order streams (4th or below).

Breeding sites include streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds (land depressions between fault zones that have filled with water), dune ponds, and lagoons. Breeding adults have been found near deep (0.7 m) still or slow moving water surrounded by dense vegetation (USFWS 2002). There is a long larval period and subsequent to hatching, larvae inhabit shallow (0.26-0.5 m) water adjacent to the main pond (Storer 1925). CRLFs are also found and breed in manmade waters, such as stock ponds, sewage treatment ponds, and artificial (concrete) pools without vegetation (Jennings, et al 1997). Data indicate that CRLFs do not frequently inhabit vernal pools, as conditions in these habitats generally are not suitable (Hayes and Jennings 1988).
CRLFs are more often found in habitats without introduced predators, such as centrarchid fish (e.g., largemouth bass), green sunfish, bluegill, crayfish, and bullfrogs (Jennings et al. 1997; Hayes and Jennings 1988). CRLFs are largely restricted to freshwater or slightly brackish water (< 9.0% salinity). Juvenile CRLFs are active during the day and night, and may be found sunning themselves on floating vegetation, while adults are mainly nocturnal (Jennings et al. 1997).
In general, dispersal and habitat use depends on climatic conditions, habitat suitability, and life stage. Adults rely on riparian vegetation for resting, feeding, and dispersal. The foraging quality of the riparian habitat depends on moisture, composition of the plant community, and presence of pools and backwater aquatic areas for breeding. During wet periods, adults can be found to move long distances (1.6 km) between aquatic habitats (Jennings et al. 1997). Winter habitats vary with locality, but generally, CRLFs seek habitat where ponds do not freeze, and dispersal seems limited and rare (Storer 1925). During dry periods, the CRLF is rarely found far from water, although it will sometimes disperse from its breeding habitat to forage and seek other suitable habitat under downed trees or logs, industrial debris, and agricultural features (UWFWS 2002). According to Jennings and Hayes (1994), CRLFs also use small mammal burrows and moist leaf litter as habitat. In addition, CRLFs may also use large cracks in the bottom of dried ponds as refugia; these cracks may provide moisture for individuals avoiding predation and solar exposure (Alvarez 2000). "

Based on these habitat requirements, the THP itself is at a slightly higher elevation than the area where "Most CRLF populations have been documented" as quoted from the above. The THP is not in a "critical habitat area" as designated by the USFWS and is not in a "core area" either. While the THP is in a potential recovery area as the historic range of CRLF is believed to include large portions of the Sierra Nevada below 1500 meters in elevation, the plan contains protections for riparian areas in the form of WLPZ regulations. With respect to the typical wet season migration phase of CRLF, the major effect of the project would be from loss of cover itself in even-age regeneration areas, however, these effects are short-term and less than significant since these areas will be promptly replanted and cover returned aided by the use of herbicides to control competing vegetation. Also, rules of the BOF requiring spacing and a time period between even-age regeneration units and size limits would require that cover would be available in between the areas affected by harvest. The long rotation age pursuant to the SPI Option "a" would mean that there would be many decades between harvest disturbances in the event that the species were to be re-introduced in its historic range in the recovery area.

Regarding Pacific fisher and pine marten, both species are mid-size predators that can utilize a wide variety of forest stand conditions. Landscapes comprised of a mix of forest stand and age classes can provide foraging, resting and denning habitat for these species. This variety of stand conditions exists within and adjacent to the THP area and will not be significantly changed by the implementation of the THP. No significant adverse effects are expected to occur to these species or their habitats from this THP.

On April 8, 2009, the California Fish and Game Commission (FGC) adopted findings declaring the Pacific fisher a candidate species under the California Endangered Species Act. At the same meeting the Commission adopted regulations allowing for the incidental take of Pacific fisher during the candidacy period provided an approved THP covers the operations. These two sets of regulations have been forwarded to the Office of Administrative Law (OAL) for review. The Office of Administrative Law published the Notice of Finding designating the fisher a candidate species under CESA on April 24th 2009.

In a statement of findings to adopt the incidental take permit, the FGC noted the following: "In making this finding, the Commission emphasizes it does not believe timber operations on an individual or collective basis will result in significant impacts to Pacific fisher during the species' candidacy. The industry engaged in timber harvesting has participated in the Commission's review and consideration of the petition to list Pacific fisher, and the Commission recognizes the industry's interest and effort in contributing to the conservation of Pacific fisher. The Commission expects these efforts will continue during the Pacific fisher's candidacy period and even with the species' status as endangered, rare, or threatened as defined by the CEQA guidelines, the Commission does not believe individual or collective timber harvest activities that could occur during the candidacy have the potential to substantially reduce the number or restrict the range of Pacific fisher." (Attachment to Notice of Exemption for Adoption of 14 CCR 749.5. April 10, 2009)

Pacific fisher is currently not found on or near SPI ownership in the Cascade and Sierra Nevada Ranges from the Pit River south to the Tuolumne County area. As a result, no current mitigation is required under CESA.

Various plant databases were checked for the potential of rare or endangered plant species that might occur on the area. The plan explains the possibility of finding locations for *Calochortus clavatus ver avius, Chlorogalum grandiflorum, Horkelia parryi, Ceanothus fresnensis, Clarkia virgata, Cypripedium fasciculatum, Cypripedium montanum, Lilium humboldtii ssp humboldtii, Mimulus inconspicuous, Mimulus laciiniatus,and Perideridia bacigalupi* in the area. Surveys for these species will be conducted prior to timber operations.

Two other mammal species of concern were considered by the Department during the review of the THP. One of these was the Sierra Red Fox. However, using the scoping process described later in this Official Response, it does not appear likely that this project would have a potential for a significant adverse impact on the species. The literature describes the range of the species to be between 3900' and 11,900' in the Sierra and primarily above 6,000'. The

species seems to prefer forested areas interspersed with open areas and a wide variety of habitats from alpine shrub, wet meadow, sub alpine conifer, montane chaparral and mixed conifer. The species eats small mammals like squirrels, gophers and rabbits. It dens in rocks, hollow logs and stumps or burrows in the ground. Overgrazing in meadows has been described as the primary reason for decline. Additionally, the animal has a large home range from 900 acres to 8000 acres in size, so it is able to search out preferred habitat over a large area. (Univ of NV, Reno) For this project area, it is noted that there will still be a variety of habitats as in the description of the preferred habitat for the species, with forested areas interspersed with open areas. The area actually harvested may add to the primary food supply as gophers, rabbits and squirrels are typical invaders that seem to do well in clearings, especially when planted with seedlings. The harvested area would also be expected to contain stumps, hollow logs and areas of rock and ground suitable for denning for the species.

Another species considered, as described briefly above, is the Pine Marten, and this species is described in some of the literature as being more common above 7,000 feet. (Storer and Usinger 1974). The animal has been known to travel up to 15 miles a day in search of food, so it can cover a wide variety of areas and habitats. (Ingels 1965). It eats grasshoppers, birds, ground squirrels and chipmunks, and even yellow jacket wasps in the fall; all of which could be expected to do well in the logged areas. It seeks shelter in tree cavities and rocks, both of which would still be present either on the project area in WLPZ retention areas or in the intervening unlogged units. From Spencer et al. (1983), Pine Marten studies done in the Tahoe National Forest showed strong presence for lodgepole pine associations and they selected against brush, mixed conifer and Jeffrey pine types at elevations below 7,000 feet. Above this elevation, Pine Marten strongly preferred red fir forest types. The THP does not contain areas of either type of favored habitat for Pine Marten.

The Salt Springs Deer Herd utilizes a portion of the project area primarily as winter range with a small portion in critical winter range. The winter range covers a very large area for the deer herd and the plan occupies only a less than significant portion of the total. There are no significant areas of critical fawning areas or critical summer range for the Salt Springs Deer Herd. The resulting mix of silvicultural types where stocking will be met upon completion with even-aged openings, WLPZs, non-timbered areas, and non-logged areas will allow for production of edge and a return to early successional vegetation types in some of these areas that are favorable for deer habitat.

A letter was submitted to the THP file from DFG dated August 29, 2001 which indicated that the Railroad Flat deer herd in the central Sierra Nevada had been declining for years, possibly as long as 30-40 years. Reasons for the decline were attributed to drought, residential and commercial development, and fire suppression efforts. The letter states, "*The impacts of timber harvesting to deer are variable, but Department deer biologists feel that some timber practices, if done with proper consideration for wildlife needs, can actually benefit California's deer herds.*" The letter also states, "*Our timber harvest review staff conduct desk reviews of all timber plans that we receive, and we currently conduct field reviews of 20-25 percent of these same plans. Desk and field reviews result in recommendations intended to protect and conserve aquatic and terrestrial resources, including deer, from adverse environmental impacts. These recommendations include retention of oaks and other wildlife habitat attributes*

where appropriate." (Curtis 2001) CAL FIRE notes that copies of this particular THP were sent to DFG for their review and input concerning not just deer, but all other species that might be adversely impacted by the proposed timber harvest operations were reviewed.

Stated in the "Report to the Fish and Game Commission (California Department of Fish and Game 2001) is a finding that deer populations have declined greatly in the Central Sierra Nevada over the past five decades and that:

> *Openings of forests as a result of post World War II logging activities (Laudenslayer and Darr 1990) likely contributed to the final peak in deer numbers in the 1960's. Deer numbers then began to decline as those forests began to "close" again. The relationship between understory forage (herbaceous and shrub) and overstory canopy is typical of much of California's forested ranges – as canopy increases, forage decreases. The expansion of urbanization and residential development on private lands into the Sierra Nevada on both the West and East slopes further reduces available deer habitat, virtually eliminating the potential to purposely restore large-scale disturbances, such as fire, into the system in many areas. It's well-documented that deer thrive on early successional vegetation in forested communities (Leopold 1950, Wallmo and Schoen 1981), and there is a period encompassing about 2-30 years following major disturbances such as fire or logging when herbaceous and shrub species are abundant, available, and in the highest quality. Livestock and perhaps hundreds of largely unstudied species of wildlife such as blue grouse or mountain quail, also rely on the vegetation produced in forest openings where sunlight is allowed to "hit the ground" and enable plants to grow and be available for consumption or as cover.* (pg. 18)

Also stated in the report for the area known as DAU 5 - Central Sierra Nevada, which is the area of concern to the proposed THP, is that:

> *The main habitat issues affecting deer in the DAU are associated with forestry practices, lack of habitat disturbance that favors early successional communities, and overuse by livestock on key summer range habitats. Human development and encroachment onto private wildlands has been significant in many areas. Presence of this urban interface, adjacent to public lands, restricts options for use of fire to manipulate habitat, thereby resulting in declining early successional habitat.* (pg 35)

It can be stated that there are only a couple kinds of disturbances that are practical and available to improve habitat for deer and other early successional wildlife on private forestlands in California. One of these is fire, both man-made and natural, and the other is harvesting or some other similar management technique. The report clearly indicates that disturbance from fire is increasingly difficult to achieve given rising populations in these areas of the Central Sierra Nevada. Even man-made fire has become increasingly difficult to accomplish due to political restrictions and objections to the addition of smoke and particulate

into the air and given the sensitivity of the populous to breathing air infused with smoke and ash.

CAL FIRE finds that opening up the canopy using silvicultural techniques that allow sunlight to reach the ground is still an economical and politically achievable way of increasing forage opportunities for deer and other early successional wildlife. Within the area of the project, there will be openings created which will allow for not only the establishment of a new generation of conifer seedlings, but also will encourage production of grass, herbs and forbs for deer foraging. While herbicides are expected to be used which would set-back or delay the development of these plant species, plants will not be eliminated by such use. There was determined to be an insignificant impact to the deer herd and recovery of the areas will be expected to be rapid, thereby returning cover to the affected areas so that any impacts would be temporary. There is no expectation of any significant adverse environmental impacts to wildlife or sensitive plants as a result of this project.

LOGGING ROADS AND LANDINGS

The rules state that all logging roads and landings shall be planned, located, constructed, reconstructed, used, and maintained in a manner which; is consistent with the long-term enhancement and maintenance of the forest resource; best accommodates appropriate yarding systems, and economic feasibility; minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water. (14 CCR Sec. 963).

For this THP, many of the roads and landings that will be needed were largely in place due to previous logging but there is a necessity to construct 5 temporary road segments into the even-age areas. The THP proposes road reconstruction and projects to improve drainage. With the approval of this THP, regulations will be in place that will require long-term road maintenance. Because of the current THP, road maintenance will be required for the period of time that the plan is active, or about 3 years time, and an additional year beyond submission of the final work completion report. Approval of this plan will result in upgrades to roads that will facilitate an improvement in the condition of the watershed through reduction of sediment sources associated with erosion from road surfaces. Likewise, numerous road crossings of watercourses will be improved with culverts or ditching.

ARCHAEOLOGICAL AND HISTORICAL RESOURCES

The purpose of the forest practice rules with respect to archaeological and historical resources is to ensure that significant sites within the area are adequately identified and protected and to provide direction to RPFs preparing THPs, Licensed Timber Operators and CAL FIRE in its review, approval and inspection programs; (14 CCR Sec 969). The results of field surveys made and mitigations designed to protect these resources are found in a portion of the THP

file that is kept confidential pursuant to Government Code Sec. 6254 and 6254.10 and are not included in any documents provided to the public. (14 CCR Sec. 895.1). This is done to protect any of these resources from possible vandalism. This confidential addendum to the THP is written by an archaeologist or RPF who has been trained in archaeology and certified. It is reviewed in CAL FIRE by either a professional archaeologist or a CAL FIRE RPF trained in archaeology, usually both, and the timber operational area itself is inspected by a CAL FIRE forest practice inspector who has had this training. Copies of the confidential addendum are sent to local tribal groups, if they are on a list that is maintained by the Native American Heritage Commission, so that their input and expertise can be sought to assist in the review of the protections for these features.

ISSUES

Three public letters of concern were received concerning this THP. These letters were from the Center for Biological Diversity (GBD). There was concern that the THP would have an adverse impact on global warming and green house gas (GHG) production. Another concern involved use of an unpublished study that was cited in the originally submitted SPI plan. The final letter of concern was in response to the re-noticed THP that contained SPI responses to the second CBD letter. The first CBD letter was submitted on about 21 THP's in California and were largely identical, with the exception of the THP number, THP name and number of logging acres in each THP.

1. Concern: It was stated that forests play an important role in reducing the amount of carbon dioxide in the atmosphere. During photosynthesis, trees breathe in carbon dioxide and breathe out pure oxygen. Through this process, forests remove massive amounts of carbon dioxide from the atmosphere each year. Forest ecosystems also serve as banks that store carbon for finite periods of time; thus, in a natural state, and/or if managed well, they are carbon sinks and not sources (Tans et al. 1990). Carbon is added to the bank regularly through photosynthesis, which removes carbon dioxide from the atmosphere and stores the carbon contained therein in the organic matter of the forest. Forest ecosystems are complex, and include not only living and dead trees but understory vegetation, and soil. Each of these elements contains carbon. For example, Turner et al. (1995) estimated that forests in the coterminous United States contain 36.7 Pg3 of carbon with half of that in the soil, one-third in trees, 10% in woody debris, 6% in the forest floor, and 1 % in the understory. The location of forest carbon is important because it helps determine how much carbon remains in storage or is lost after disturbances like logging. Changes in land use and forestry practices can emit carbon dioxide (e.g., through conversion of forest land to agricultural or urban use, or through logging) or can act as a sink for carbon dioxide (e.g., through net additions to forest biomass). Regardless of the exact number, it is clear that if forests are protected and allowed to flourish they have the potential to store and sequester a significant amount of carbon. Evidence abounds on this topic. For example It is estimated that from 1952-1993, carbon storage in American forests increased by 38% (Birdsey et al. 1993). The authors hypothesize that this may be due to biomass accumulation in temperate forests over the time period. Birdsey and Heath (1995) estimated that in 1995 the United States contained 298 million hectares of forests, which stored 54.6 billion metric tons of organic carbon above and below the ground. This amounted to five percent of all the carbon stored in the world's forests. Pacala et al. (2001) estimated that the coterminous United

States was an annual carbon sink of between 0.3 and 0.58 Pg of carbon annually, with half of the storage occurring in forest ecosystems. Land use, land-use change, and forestry activities in 2006, resulted in a net carbon sequestration of 883.7 Tg CO_{2e}, with 745 Tg of this coming from forest land that was allowed to remain as forest land. Forests (including vegetation, soils, and harvested wood) accounted for approximately 84 percent of total 2006 net C02 flux (EPA 2008). Overall in 2006, these activities represent an offset of approximately 14.8 percent of total U.S. CO_2 emissions, or 12.5 percent of total greenhouse gas emissions in 2006 (EPA 2008). Between 199and 2006, total land use, land-use change, and forestry net carbon flux resulted in a 20 percent increase in CO_2 sequestration, primarily due to an increase in the rate of net carbon accumulation in forest carbon stocks, particularly in aboveground and belowground tree biomass (EPA 2008). The net forest sequestration is a result of net forest growth and increasing forest area, as well as a net accumulation of carbon stocks in harvested wood pools. Peters et al. (2007) concluded that North American ecosystems remove 0.65 Pg C/year, offsetting one-third of the 1.85 Pg carbon emissions. Forests account for the majority of this uptake. Certain forest management actions, and timber harvest in particular, allow stored carbon to be released into the atmosphere. Thus, in addition to affecting habitat, these anthropogenic activities serve as a withdrawal from the forest carbon bank carbon is removed from long-term storage and released to the atmosphere, exacerbating global warming and climate change. Sohngen and Sedjo (2000) estimated that private timberlands in North America stored 46 Tg of carbon/year but released an average of 43 Tg carbon/year from 1995-2005, resulting in a net storage of only three Tg carbon/year. Similarly, other researchers have found large proportions of sequestered carbon are quickly released on private forests (Birdsey et al. 1993; Turner et al. 1995). This can be largely attributed to a difference in management styles as industrialized forests typically put an even greater priority and focus on logging and tree harvesting. Evidence shows that the carbon dioxide releases from logging can be substantial. In a letter to the California Air Resources Board regarding California Climate Action Registry Forest Protocols, Harmon (2007) wrote: Timber harvest, clear cutting in particular, removes more carbon from the forest than any other disturbance (including fire). The result is that harvesting forests generally reduces carbon stores and results in a net release of carbon to the atmosphere. Modeling exercises predict that the amount of carbon sequestered by timberlands in the United States is decreasing. For example, Turner et al. (1995b) found that while U.S. forests sequestered carbon at a rate of 8Tg yr in the 1990s, these same forests will come close to carbon equilibrium by the 2030s. They state that the most important factor in the declining strength of the forest land base sink is a relatively large increase in harvest levels. Turner et al. (1995b) predict a rise

in average tree growth on private timberland in the U.S. from 204 g m yr in the 1990s to 22g m yr in the 2030s (or from 258 to 293 Tg yr). However, this will be offset because the harvest level rises much faster, with tree carbon removals on private timberland increasing by 85 Tg yr over the 5year scenario. Private timberland begins losing carbon midway through the scenario causing forests to transform from sinks to sources largely due to the loss of trees to logging. In this same study, however, increases in carbon sequestration up to 15 Tg per year were found when alternative forest policy options were adopted, such as increased afforestation and practices related to increase paper recycling (Turner et al. 1995b). These researchers state that the current forest land base acts to currently offset 6% of U.S. fossil carbon emissions but that proportion is likely to decrease over the coming decades unless changes are made in logging practices and land management (Turner et al 1995b). This is especially alarming because conservative estimates project a steady 1 to 2 % increase of fossil carbon emissions for the United States per year. At the same time, the carbon sink associated with the forest land base is projected to decrease (Turner et al 1995b). Thus, the carbon sink associated with the forest sector in the United States will offset a decreasing proportion of national fossil carbon emissions over the coming years unless changes in logging practices and land-use management are made. The total land area of the United States is 765.5 x 1hectares, of which 200.7 x 10^6 is timberland (Turner et al. 1995). Depending on how it is treated, all of this timberland has the potential to act as a sink, removing and storing carbon dioxide, or a source that releases carbon dioxide into the atmosphere. Turner et al. (1995) estimate annual uptake on United States forests at 331 Tg, but stated that they were largely balanced (266 Tg) by annual losses from logging and decay. Turner et al. (1995) suggest that in light of climate change and further disturbance, we need to pay close attention to harvest sizes and trends due to the fact that In the U.S., projections call for a 5% loss in the private timberland area by the year 204(Alig et al. 1990). A general intensification of forest management, resulting in lower carbon storage per unit area (Cooper 1983, Dewer 1991), and a gradual increase in the harvest level (Haynes 1990), are also expected. These factors will tend to mitigate against a stable or increasing carbon sink (Turner et al. 1993). Increasing temperatures, atmospheric C02, and nitrogen deposition could promote higher growth rates (McGuire et al. 1993), but projected climate change is also likely to produce a transient release of forest carbon because carbon sources associated with increasing disturbance rates would be greater than carbon sinks associated with land recovering from disturbance (King and Neilson 1992). Clearly, land management, and specifically forest management, plays a major role in the global carbon balance. How California chooses to manage its forests - including private forests - has a significant effect on how much

carbon dioxide is released and stored. If we are to maintain public and private forests as carbon sinks, which is now more important than ever, continued cumulative disturbance from logging must be reduced.

Response: CAL FIRE has carefully reviewed the literature citations from the comment letter in order to determine the impact that scientific studies might have on any finding that the Department might make on any particular THP or cumulative groups of THPs with respect to a potential significant adverse environmental impact on GHG. With this in mind, the Department reviewed the publication by Tan et al. (1990). CAL FIRE does not find that the study relates well to the "forest" ecosystem as the impetus of the study is to examine the global atmospheric CO_2 budget. The closest the study comes to evaluating the forest is in terms of the entire terrestrial ecosystem. Of course, this would include forests, but also include a lot more than just forestland on a global basis. The report also concludes: "From 1981 to 1987 atmospheric CO_2 increased at an average rate of 3.0 Gt of C per year. The release of CO_2 from fossil fuel burning (5.3 Gt of C per year) and land use modification (0.4 to 2.6 Gt of C per year) is being partially balanced by the uptake of CO_2 by the oceans and by terrestrial ecosystems. Observations and simulations of the meridional gradient of CO_2 in the atmosphere suggests that these sinks are larger in the Northern Hemisphere than in the Southern Hemisphere." There is nothing in this conclusion that isolates the role of just forests alone in the equation. The report goes on to discuss the difficulty of determining or isolating the role of components of the system by simply measuring atmospheric CO_2 since: "Data from the present international network of CO_2 monitoring sites, located almost exclusively in oceanic areas cannot be used to resolve longitudinal gradients, and thus identification of the important source-sink areas is currently difficult." Again, the study which uses total atmospheric CO_2 as a point of measurement is not going to be very helpful in determining the role of GHG contributions as a sink-source of forests as a stand-alone component.

The study from Turner et al. (1995) also states with respect to the role of carbon sequestration from different timber stand ages: "Later in stand development, forest ecosystems are strong carbon sinks. In late succession, rates of tree carbon gain are moderated because greater tree height means more sapwood maintenance respiration and possibly reduced photosynthetic rates." Turner et al. (1995) also states that: "Half the total timberland carbon is in mineral soil." and "A recent review of studies in temperate forests did not indicate a significant decrease in soil organic carbon after tree harvest." It should be noted that some other studies are quoted in the public comment letter than came to different conclusions regarding the fate of soil carbon after harvest disturbance, but this report supported a conclusion that there is not much of a change in soil C from harvest. Turner also states that: "The net effect of forest growth and microbial decomposition is a transfer of 308 Tg/yr of carbon from the atmosphere into organic matter. This rate of potential accumulation is possible only because the removal of carbon by harvesting has tended to maintain large area in the early to middle stages of stand development which favor carbon accumulation. Under unmanaged conditions the rate of carbon accumulation on the same land base would be lower or even negative, because fire and increased rates of woody debris decomposition would balance uptake. The potential accumulation of 308 Tg/yr is partially offset by harvest related carbon removed from the forest land base totaling 124 Tg/yr and harvest emissions of 105 Tg/yr. The difference between biological flux and the losses associated with harvest is a carbon gain of 79 Tg/yr on the forest land base." While some of these same figures are quoted in the public concern letter, what is left off is the math that shows a very large carbon sequestration under the

conditions that existed up until the date of the report in 1995. This total gain occurred at a time where there was little or no effort being made to increase the rates of carbon sequestration, either from improved technology, genetics or from conversion of non-timbered areas to planted areas. This is also without the knowledge of the significant decrease in harvesting on USFS public lands throughout the United States as a matter of public policy and of harvesting in particular on California private/public lands that has occurred in recent times. (see BOE Timber Tax Graph below in this Official Response).

CAL FIRE also reviewed Birdsey et al. (1993), which also does not take into account the significant decrease in harvesting on USFS public lands throughout the United States as a matter of public policy and of harvesting in particular on California private/public lands that has occurred in recent times. Birdsley also states that the total amount of carbon stored in all the US forests amounts to a relatively insignificant 4% of the world's total, which is an interesting statistic when considering the cumulative impacts of something like CO_2 which is atmospheric and able to travel over and through any political boundaries. Also, Birdsey et al. (1993) discusses: "Most of the carbon in the US forest ecosystem is stored below the ground. Trees, including tree roots, account for 31% of all forest ecosystem carbon. The soil contains 59% of the carbon." Since "tree roots" are not proposed for removal in this particular THP, or for that matter in any typical THP, these elements of carbon are going to remain in place to add to the 59% of soil carbon that Turner et al. (1995) above states: "A recent review of studies in temperate forests did not indicate a significant decrease in soil organic carbon after tree harvest." Forest products themselves, which are removed, continue to store carbon in many cases as well, as stated by Birdsey et al. (1993) as follows: "The end-use of timber harvested from forests is an additional factor in evaluating the contributions of forestry to the global carbon cycle. Carbon may be stored for long periods of time, in durable goods such as furniture or timber bridges, or as discarded wood products in landfills." Again, regarding the role of stand age in carbon sequestration, Birdsey et al. (1993) states: "Young growing forests take up carbon at high rates, while carbon uptake in mature forests is roughly balanced by carbon release."

Birdsey and Heath (1995) found that "Forest disturbances such as fire or timber harvest may add to the pool of CO_2 in the atmosphere, while growing forests may reduce atmospheric CO_2 through increases in biomass and organic matter accumulation." and "A search of the literature indicated that a major forest disturbance, such as a clearcut harvest, can increase coarse litter and oxidation of soil organic matter. The balance of these two processes can result in a net loss of 20% of the initial cover over a 10-15 year period following harvest (Pastor & Post, 1986; Woodwell et al., 1984) <u>although a recent review suggested the net effect may be less or even positive in many cases</u> (Johnson 1992)." (emphasis added) Birdsey and Heath (1995) also agreed with the quote from Birdsey et al. (1993) above that US forests store 5% of all the carbon stored in the world's forests. This is stored in 298 million hectares of US forests. Given the math, the total amount of SPI ownership in relation to the US forests is about .167% and the total size of this particular THP in relation to US forests, or the world's total, is not measurable. Birdsey and Heath (1995) also agrees with CAL FIRE findings about the fall-off of harvest levels in recent times, particularly on public lands: "With restrictions on harvest levels, carbon storage on National Forests is expected to increase substantially, with an average annual addition to carbon storage of about 83 million metric tons per year between 2000 and 2040. Other public forests show similar but less pronounced changes."

Pacala et al. (2001) was examined by CAL FIRE and states: "Wood products create a carbon sink because they accumulate both in use and in landfills". Also, "Atmosphere-based results for 1980-89 are similar to those for 1985-1989 and 1990-1994, indicating a relatively stable US sink throughout the period." Also interesting were the statistics about the contributions that fire control has had on carbon storage over the long-term where current levels of carbon released into the atmosphere from that source are so much less than historic trends, as follows: "Before the middle of the 19th Century, about 80 million ha of land burned annually, mostly in unforested parts of the western US. The area burned has now been reduced by more than 95% and woody plants that were historically excluded by recurrent fires are now encroaching over large areas." This is especially interesting to CAL FIRE as an agency involved in fire and forest management and the reduction of areas burned and converted from carbon sequestering timberland and wildland.

The study from Peters et al. (2007) noted that the year 2002 was an especially bad year for C uptake on a world-wide basis. However, the report found that the failure or success of any particular year with respect to C uptake was more related to drought or excessive rainfall rather than to harvest or fire occurrence.

The report by Sohngen and Sedjo (2000) found an interesting thing with respect to developments in intensive forest management in a changing economic time that is typically not considered in other studies done in the area of carbon uptake, as follows: "...if future prices are predicted to rise, landowners will respond by increasing management intensity. Management intensity includes a range of activities such as conversion of natural forests to plantations, genetically engineered species, and the establishment of new plantations." And "Further, some global studies of carbon such as Solomen et al. (1993) and Goldewijk et al. (1994) do not attempt to capture changes in management intensity and they consequently may <u>underestimate</u> carbon sequestration in forests." (emphasis added) CAL FIRE finds that this is perhaps a fact overlooked particularly in relation to the current project and similar THPs that are submitted by the applicant SPI, where there is a great deal of expense and effort made in planting genetically improved seedlings and in managing tree spacing and control of competing understory vegetation.

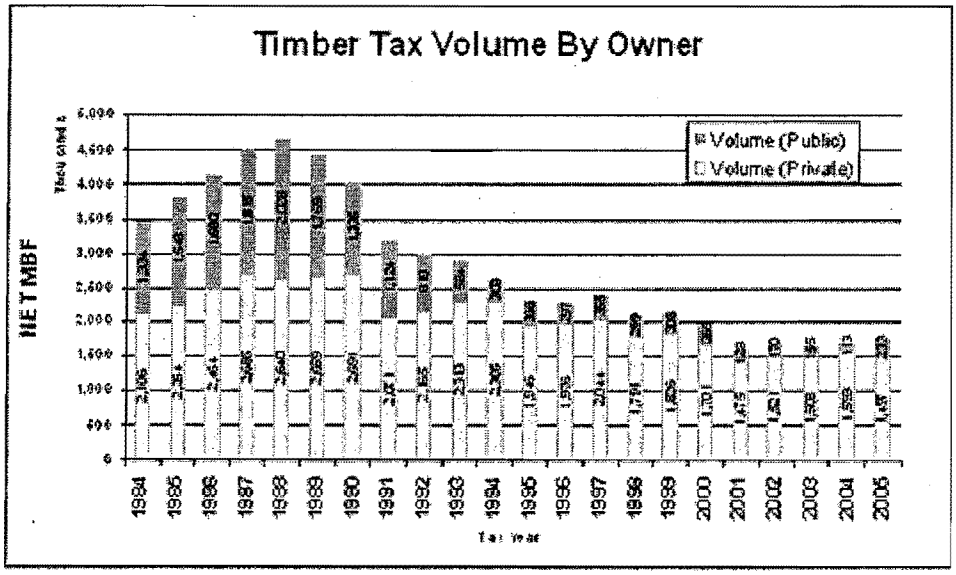
The Department also looked at Harmon (2007) and noted that, while the quote from the letter-of-concern indicated that clearcutting would be expected to remove more carbon from the forest than wildfire, but another quote from the document states: "...there is a grain of truth to the assertion that forests at a relatively young age do have the potential to take up more carbon than older forests." The Department would concur that removal of carbon would be more likely in a clearcut than a wildfire just because of the volume of wood removed would be more complete in a mechanical clearcut than a random event like a wildfire. In a wildfire, snags are potentially left on site. However, the eventual fate of the snags would find that they decay back into the atmosphere or the soil within a decade or two, while the carbon in the wood manufactured from a timber harvest would go into storage for many decades in the form of lumber products. Harmon (2007) also notes the difficulty of measuring carbon loss/sequestration as follows: "While it would be ideal if one could directly measure all the forest carbon, this is not practical at this time." and "I see nothing whatsoever preventing landowners from developing biomass equations that are equally credible." However, with respect to technologies or techniques that do not exist prior to the

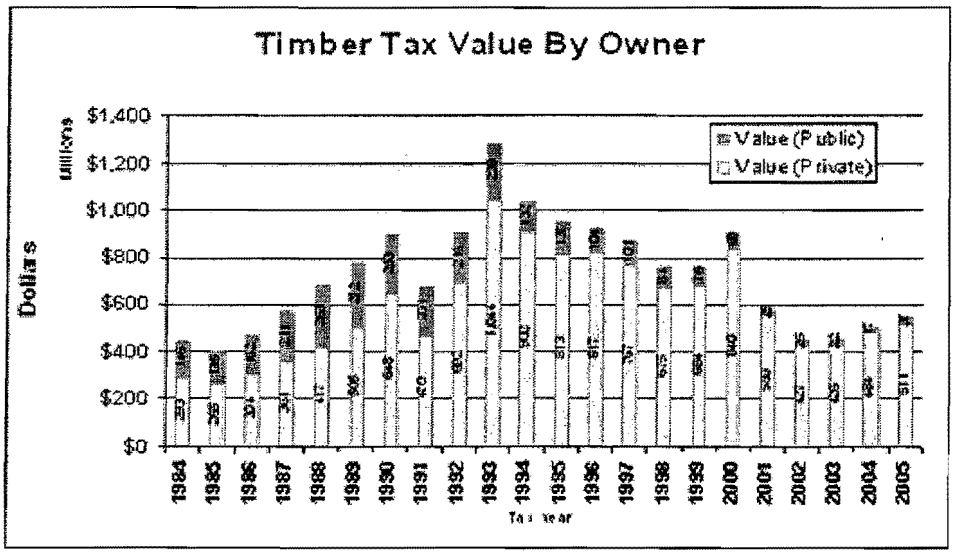
submittal of a THP, the rules of the BOF state in 14 CCR Sec. 952.9 that "The RPF preparing a THP shall conduct an assessment based on information that is reasonably available before submission of the THP." Where these techniques or applications are not available or have not been peer reviewed or supported by political entities such as the BOF prior to THP submittal, they are not required to be invented.

In Turner et al. (1995b), there is also the problem that predictions of harvest levels have occurred at a time of maximum harvest and there was no knowledge that harvest would fall-off so dramatically, especially in California as shown in the BOE Timber Tax Graph below. Turner et al. (1995b) makes it sound like any findings of any reporting on the fate of carbon are suspect by stating: "For the US in particular, an improved forest inventory and inventory projections on public lands is needed, since historically, the USDA Forest Service forest inventory and analysis units have surveyed primarily private timberlands. A better understanding of soil carbon and woody debris dynamics following harvest is also needed. Assumptions of significant losses in soil carbon after harvest and gains later in stand development, which have been employed in earlier carbon budget models (Houghton et al, 1983; Heath & Birdsley, 1993) may not be warranted in temperate zone forests. Any effort to model biologically-based processes over the coming decades should also track the potential effects of higher CO_2 and projected climate change on forest productivity and distribution."

Regarding the aforementioned fall-off of timber harvest in California on both public and private timberlands, the following table is presented from data gathered by the State of California Board of Equalization Timber Tax Division.
From: http://frap.cdf.ca.gov/projects/BOE/BOETimberTax.html).

California Timber Yield Tax Volume and Value Trends





While the BOE findings show a very significant decline of federal harvesting, the BOE chart of harvesting levels from 1978 to 2007 show that harvesting on private lands have also fallen off significantly. From a high of 2,695 MMBF in 1990, the levels on harvesting on private lands administered by CAL FIRE has fallen to 1,440 MMBF, or a decrease of 47%. The take-away message from these statistics is that California's forests have a very good chance of meeting the recently enacted CARB and AB32 goals by providing more carbon sequestration based on a falling level of harvest when compared to the high point of harvesting which occurred around 1990.

Forest Practice Regulatory Background

The Z'berg-Nejedley Forest Practice Act (Division 4, Chapter8, PRC) establishes the necessity for Timber Harvesting Plans to conduct commercial timber operations and establishes the Board of Forestry and Fire Protection as the regulatory authority for promulgation of regulations to among other things"...assure the continuous growing and harvesting of commercial forest tree species and to protect the soil, air, fish and wildlife, and water resources, including but, not limited to, streams, lakes and estuaries."

The FPA was initially adopted in 1973. Since that time the BOF has enacted numerous regulations to support act intent related to sustained yield and has adopted conservation standards for post-harvest stocking that meet or exceed the minimum resource conservation standards specified in PRC 4561 of the Act. The Board has established rules related to demonstration of Timberland Productivity, Sustained Forestry Planning (14 CCR 913.10), demonstration of Maximum Sustained Productivity (14 CCR 913.11), and has defined sustained yield and long term sustained yield (14 CCR 895.1). Under these various rule provisions, landowners with more than 50,000 acres of timberland are required to demonstrate long-term sustained yield under the management regime they have selected for the ownership. Under this provision, the Department has received and approved long term sustained yield document covering approximately 3.2 million acres of timberland.

While the BOF has not yet directly addressed CO_2 in its regulatory language, there are a host of Board rules as described in the above paragraph that address forest sustainability and which can help to preserve the ability of California's forests to continue to sequester carbon by; recognizing the importance of old-growth forests that are shown in literature to play an important role in carbon sequestration; limiting the spacing and use over time of even-age treatments which are shown in some studies to create some level of carbon release on short-term basis; regulating the conversion of forests to other non-forest uses which has been shown in many studies to reduce the potential for carbon sequestration and elevate carbon release on a long-term basis; requiring planting of trees or leaving trees that are capable of replacing trees that are harvested (stocking); allowing for the capture of mortality through easily processed exemptions or emergency notices which can help forest sustainability by reducing the potential of spread of insect or disease or allow salvage of fire damaged trees to be made in to carbon sequestering forest products; and addressing forest sustainability through the requirements of MSP/LTSY. Following is a brief compendium of the Board rules that most apply to the issue of forest sustainability as a mechanism to help address the newly developing issue of carbon sequestration:

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919.16, 939.16, 959.16 Late Succession Forest Stands [All Districts]

(a) When late succession forest stands are proposed for harvesting and such harvest will significantly reduce the amount and distribution of late succession forest stands or their functional wildlife habitat value so that it constitutes a significant adverse impact on the environment as defined in Section 895.1, the RPF shall provide habitat structure information for such stands. A statement of objectives over time shall be included for late succession forest stands on the ownership. The THP, SYP, or NTMP shall include a discussion of how the proposed harvesting will affect the existing functional wildlife habitat for species primarily associated with late succession forest stands in the plan or the planning watershed, as appropriate, including impacts on vegetation structure, connectivity, and fragmentation. The information needed to address this subsection shall include, but is not limited to:

(1) - A map(s) showing: A) late succession forest stands within the planning watershed and any other stands that provide functional wildlife habitat for species primarily associated with late succession forest stands that are on the ownership, B) those stands which are currently proposed to be harvested, and C) known stands on other ownerships.

(2) - A list of fish, wildlife and listed species known to be primarily associated with the late succession forest stands in the planning watershed(s) compiled by the RPF or supervised designee using the "California Wildlife Habitat Relationships System" (WHR), the California Natural Diversity Database, and local knowledge of the planning watershed.

(3) - Description of functional wildlife habitat elements that are important for fish, wildlife and listed species primarily associated with late succession forest stands within the planning watershed(s).

(4) - A description of the structural characteristics for each late succession forest stand and any other stands that provide functional wildlife habitat for species primarily associated with late succession forest stands within the planning watershed including a discussion of important functional wildlife habitat elements identified in (3). Methods used to develop the description, which may be an ocular estimate, shall also be described.

(5) - A description of the functional wildlife habitat objectives, such as anticipated long-term landscape patterns, stand structure for late succession forest stands and any other stands that provide functional wildlife habitat for species primarily associated with late succession forest stands, and a discussion of anticipated recruitment procedures for important functional wildlife habitat elements. Coordination of functional wildlife habitat objectives on landscape features among ownerships within mixed-ownership planning watersheds is encouraged.

(6) - An analysis of the long-term significant adverse effects on fish, wildlife, and listed species known to be primarily associated with late succession forests.
(b) Where timber operations will result in long-term significant adverse effects on fish, wildlife, and listed species known to be primarily associated with late succession forests in a THP, SYP, NTMP or planning watershed, feasible mitigation measures to mitigate or avoid such long-term significant adverse effects shall be described and incorporated in the THP, SYP or NTMP. Where long-term significant adverse effects cannot be avoided or mitigated, the THP, SYP, or NTMP shall identify the measures that will be taken to reduce those remaining effects and provide reasons for overriding concerns pursuant to 14 CCR Section 898.1 (g), including a discussion of the alternatives and mitigation considered.

(c) A THP, SYP, or NTMP submitter may request that the Director waive subsection (a) above. The Director, after conferring with review team agencies with jurisdiction, may waive subsection (a) above when substantial evidence is presented that would support a determination that post-harvest late succession forest stands or functional wildlife habitat will continually provide adequate structure and connectivity to avoid or mitigate long-term significant adverse effects on fish, wildlife, and listed plant species known to be primarily associated with late succession forest stands within the planning watersheds.

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913.1, 933.1, 953.1 Regeneration Methods Used in Evenaged Management [All Districts; Note variation by District in (a)(4)(A) and (d)(3) Shelterwood Removal Step]
The following types of regeneration methods are designed to replace a harvestable stand with well spaced growing trees of commercial species. Evenaged management systems shall be applied with the limitations described by this rule:
(a) Timber stands harvested under an evenaged regeneration method shall meet the following standards:
(1) Where a regeneration step harvest of evenaged management will occur on stands younger than 50 years of age for Class I lands, 60 years of age for Class II and III lands, or 80 years of age for Class IV and V lands, or equivalent age of trees, based on height as determined according to the appropriate site class, the RPF preparing the THP or SYP must demonstrate how the proposed harvest will achieve MSP pursuant to 14 CCR § 913.11 [933.11, 953.11](a) or (b) provided, however, that the Director may grant an exemption from this section based upon hardship.
(2) The regeneration harvest of evenaged management shall be limited to 20 acres for tractor yarding. Aerial or cable yarding may be 30 acres. Tractor yarding may be increased to 30 acres where the EHR is low and the slopes are < 30%. The RPF may propose increasing these acreage limits to a maximum of 40 acres, and the Director may agree where measures contained in the THP provide substantial evidence that the increased acreage limit does any one of the following:
(A) by using additional on-site mitigation measures, reduces the overall detrimental effects of erosion thereby providing better protection of soil, water, fish and/or wildlife resources; or
(B) provides for the inclusion of "long corners"; or
(C) create a more natural logging unit by taking maximum advantage of the topography; or
(D) will increase long-term sustained yield; or
(E) provide feasible off-site mitigation measures that can be incorporated in the plan to restore or enhance previously impacted resource areas or other environmental enhancements that will result in demonstrable net environmental benefits within the planning watershed. These measures may include, but are not limited to, watercourse restoration, soil stabilization, road surface stabilization, road outsloping, road abandonment, road reconstruction, enhancement of wildlife habitats and vegetation management. To qualify for an exemption the plan submitter is not required to demonstrate that other feasible options are not available. **(3)** Evenaged regeneration units within an ownership shall be separated by a logical logging unit that is at least as large as the area being harvested or 20 acres, whichever is less, and shall be separated by at least 300 ft. in all directions.

(4) Within ownership boundaries, no logical logging unit contiguous to an evenaged management unit may be harvested using an evenaged regeneration method unless the following are met:
(A) [Coast] The prior evenaged regeneration unit has an approved report of stocking, and the dominant and codominant trees average at least five years of age or average at least five ft. tall and three years of age from the time of establishment on the site, either by the planting or by natural regeneration. If these standards are to be met with trees that were present at the time of the harvest, there shall be an interval of not less than five years following the completion of operations before adjacent evenaged management may occur.

(A) [Northern and Southern] The prior evenaged regeneration unit has an approved report of stocking, and the dominant and codominant trees average at least five feet tall, or at least five years of age from the time of establishment on the site, either by the planting or by natural regeneration. If these standards are to be met with trees that were present at the time of the harvest, there shall be an interval of not less than five years following the completion of operations before adjacent evenaged management may occur.

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1103 Conversion of Timberland
Any person, firm, corporation, company, partnership or government agency owning timberland for which the timberland owner proposes conversion as defined in Section 1102 shall apply to the Director on a form prescribed by him for issuance of a Timberland Conversion Permit.
1103.1 Prohibited Activity
(a) No timber operations or other conversion activities shall be conducted on timberland which is proposed to be converted to a use other than the growing of timber unless a conversion permit has been issued by the Director or the Board upon appeal and the permit has been recorded in compliance with 14 CCR [*1106.3*](a).
(b) No timber operations shall be conducted on timberland for which a conversion permit has been issued until a Timber Harvesting Plan has been filed with and found in conformance by, the Director in accordance with Article 7 (commencing with Sec. 4581) of Chapter 8, Part 2, Division 4 of the PRC and the rules and regulations of the Board issued pursuant thereto.

(c) The timberland owner shall provide each timber operator copies of both the recorded conversion permit, and recorded amendments thereto, and the approved THP. Copies of said documents shall be conveniently available for inspection at all times during timber operations conducted pursuant to said conversion permit.

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1070 Stocking Sampling
The objective of this article is to describe the stocking sampling procedures that the timber owner or his agent shall use to determine if the stocking standards of the Act and rules have been met following the completion of a timber operation.
1071 Minimum Stocking Standards
Within five years after the completion of timber operations or as otherwise specified in the rules, a report of stocking on the entire area logged under the plan and shown on a revised map shall be filed with the Director by the timber owner or the agent thereof. If stocking is required to be met upon completion of timber operations the stocking report shall be submitted within six months of the completion of operations.
The minimum acceptable stocking standards on logged areas which were acceptably stocked prior to harvest are those specified in the Coast, Northern, and Southern Forest District rules. If not otherwise specified, the following minimum standards apply:
(a) On Site I timberlands as defined by the Board, the average residual basal area, measured in stems one inch or larger in diameter shall be at least 85 square feet per acre; or on Site II or lower shall be at least 50 sq. ft. per acre; or
(b) The area contains an average point count of 300 per acre on Site I, II, and III lands or 150 on Site IV and V lands as specified in PRC 4561.

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1038 Exemption

Persons who conduct the following types of timber operations are exempt from the plan preparation and submission requirements (PRC § 4581) and from the completion report and stocking report requirements (PRC §§ 4585 and 4587) of the Act with the following exceptions and requirements:

(i) no tree that existed before 1800 A.D and is greater than sixty (60) inches in diameter at stump height for Sierra or Coastal Redwoods, and forty-eight (48) inches in diameter at stump height for all other tree species shall be harvested unless done so under the conditions or criteria set forth in subsection 1038(h).

(ii) all timber operations conducted in the Lake Tahoe Region pursuant to 14 CCR § 1038 must have a valid Tahoe Basin Tree Removal Permit (as defined by the Tahoe Regional Planning Agency) or shall be conducted under a valid TRPA Memorandum of Understanding (MOU), when such a permit is required by TRPA.

(a) Harvesting Christmas trees.

(b) Harvesting dead, dying or diseased trees of any size, fuelwood or split products in amounts less than 10% of the average volume per acre when the following conditions are met:

(1) No tractor or heavy equipment operations on slopes greater than 50%.

(2) No construction of new tractor roads on slopes greater than 40%.

(3) Timber operations within any Special Treatment Area, as defined in 14 CCR 895.1, shall comply with the rules associated with that Special Treatment Area.

(4) No tractor or heavy equipment operations on known slides or unstable areas.

(5) No new road construction or reconstruction, as defined in 14 CCR 895.1.

(6) No heavy equipment operations within the standard width of a watercourse or lake protection zone, as defined in 14 CCR 916.4 [936.4, 956.4](b), except for maintenance of roads and drainage facilities or structures.

(7) No known sites of rare, threatened or endangered plants or animals will be disturbed, threatened or damaged.

(8) No timber operations within the buffer zone of a sensitive species, as defined in 14 CCR 895.1.

(9) No timber harvesting within the standard width of a watercourse or lake protection zone, as defined in 14 CCR 916.4 [936.4, 956.4](b), except sanitation-salvage harvesting, as defined in 14 CCR 913.3 [933.3,953.3], where immediately after completion of operations, the area shall meet the stocking standards of 14 CCR 912.7 [932.7,952.7](b)(2), or, except the removal of dead or dying trees where consistent with 14 CCR 916.4 [936.4,956.4] (b). Trees to be harvested shall be marked by, or under the supervision of, an RPF prior to timber operations.

(10) No timber operations on any site that satisfies the criteria listed in 895.1 for a significant archaeological or historical site. Information on some of these sites may be available from the Information Centers of the California Historical Resources Information System within the Department of Parks and Recreation.

(c) The cutting or removal of trees in compliance with sections 4290 and 4291 which eliminates the vertical continuity of vegetative fuels and the horizontal continuity of tree crowns for the purpose of reducing flammable materials and maintaining a fuelbreak to reduce fire spread, duration, and intensity.

(1) Only trees within one-hundred-fifty feet from any point of an approved and legally permitted structure that complies with the California Building Code may be harvested.

(2) The following silvicultural methods may not be used: clearcutting, seed tree removal step, shelterwood removal step.

(3) All surface fuels created by timber operations under the exemption which could promote the spread of wildfire, including logging slash and debris, deadwood, branches exceeding 1 inch in diameter, and brush, shall be chipped, burned, or removed within 45 days from the start of timber operations.

(4) In addition to the slash treatment described in [14] CCR 1038(c)(3), the areas of timber operations must meet the vegetation treatment standards in PRC 4584(j)(1) to (2)(A) illustrated in Technical Rule Addendum No.4 within one year from the receipt of issuance of Notice of Acceptance.

(5) In addition to the limitations listed in 1038(b)(1)-(10), the following apply:

(A) The timber operator shall provide the Director the tentative commencement date of timber operations on the notice required in 14CCR 1038.2. Within a 15 day period before beginning timber operations, the timber operator shall notify CDF of the actual commencement date for the start of operations. The starting date shall be directed to the designated personnel at the appropriate CDF Ranger Unit Headquarters by telephone or by mail.
(B) Timber operations conducted under this subsection shall conform to applicable city or county general plans, city or county implementing ordinances, and city or county zoning ordinances within which the exemption is located. The timber operator or timberland owner shall certify that the city or county has been contacted and the exemption conforms with all city or county regulatory requirements.
(C) Timber operations may not be conducted without a copy of the Director's notice of acceptance of the exemption at the operating site, except where the Director has failed to act within the 5 working-day review period.
(d) The limit of 10% of the volume per acre in (b) above does not apply when harvesting dead trees which are unmerchantable as sawlog-size timber from substantially damaged timberlands, as defined in 14 CCR 895.1, and the following conditions are met:
(1) Timber operations shall comply with the limits established in 14 CCR 1038(b)(1)-(10).
(2) The landowner shall notify the Director of the completion of timber operations within 30 days of their cessation.
(3) At least one inspection conducted by the Director shall be made after completion of operations (Section 4604 PRC).
(4) The RPF certifies that the timberland is substantially damaged.
(5) The RPF shall also certify that no conditions were identified where operations, conducted in compliance with the rules of the Board, would reasonably result in significant adverse effects.
(e) Operations pursuant to an exemption under subsection (c), (d) and (i) may not commence for five working days from the date of the Director's receipt of the Notice of Exemption unless this delay is waived by the Director, after consultation with other state agencies. The Director shall determine whether the Notice of Exemption is complete, and if so, shall send a copy of a notice of acceptance to the submitter. If the Notice of Exemption is not complete and accurate, it shall be returned to the submitter and the timber operator may not proceed. If the Director does not act within five days of receipt of the Notice of Exemption, timber operations may commence.

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1052.1 Emergency Conditions
The following are conditions that constitute an emergency pursuant to 14 CCR 895.1:
(a) Trees that are dead or dying as a result of insects, disease, parasites, or animal damage.
(b) Trees that are fallen, damaged, dead or dying as a result of wind, snow, freezing weather, fire, flood, landslide or earthquake.
(c) Trees that are dead or dying as a result of air or water pollution.
(d) Cutting or removing trees required for emergency construction or repair of roads.
(e) Where high, very high or extreme fuel hazard conditions, the combination of combustible fuel quantity, type, condition, configuration and terrain positioning, pose a significant fire threat on private timberlands. Cutting and removal of hazardous fuels, including trees, shrubs and other woody material, is needed to eliminate the vertical and horizontal continuity of understory fuels, and surface fuels, and/or crown fuels, for the purpose of reducing the rate of fire spread, fire duration and intensity, and fuel ignitability.
The following are conditions that constitute a financial emergency as defined in 14 CCR 895.1:

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913.11, 933.11, 953.11 Maximum Sustained Production of High Quality Timber Products
The goal of this section is to achieve Maximum Sustained Production of High Quality Timber Products (MSP). MSP is achieved by meeting the requirements of either (a) or (b) or (c) in a THP, SYP or NTMP, or as otherwise provided in Article 6.8, Subchapter 7.
(a) Where a Sustained Yield Plan (14 CCR § 1091.1) or Nonindustrial Timber Management Plan (NTMP) has not been approved for an ownership, MSP will be achieved by:
(1) Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment.
(2) Balancing growth and harvest over time, as explained in the THP for an ownership, within an assessment area set by the timber owner or timberland owner and agreed to by the Director. For purposes of this subsection the sufficiency of information necessary to demonstrate the balance of growth and harvest over time for the assessment area shall be guided by the principles of practicality and reasonableness in light of the size of the ownership and the time since adoption of this section using the best information available. The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon. The average annual projected yield over any rolling 10-year period, or over appropriately longer time periods for ownerships which project harvesting at intervals less frequently than once every ten years, shall not exceed the projected long-term sustained yield.
(3) Realizing growth potential as measured by adequate site occupancy by species to be managed and maintained given silvicultural methods selected by the landowner.
(4) Maintaining good stand vigor.
(5) Making provisions for adequate regeneration. At the plan submitter's option, a THP may demonstrate achievement of MSP pursuant to the criteria established in (b) where an SYP has been submitted but not approved.
(b) Where a SYP or NTMP is submitted for an ownership, an approved SYP or NTMP achieves MSP by providing sustainable harvest yields established by the landowner which will support the production level of those high quality timber products the landowner selects while at the same time:
(1) meeting minimal stocking and basal area standards for the selected silvicultural methods as provided in these rules as described;
(2) protecting the soil, air, fish and wildlife, water resources and any other public trust resources;
(3) giving consideration to recreation, range and forage, regional economic vitality, employment and aesthetic enjoyment;
(4) balancing growth and harvest over time. The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon. The average annual projected yield over any rolling 10-year period, or over appropriately longer time periods for ownerships which project harvesting at intervals less frequently than once every ten years, shall not exceed the projected long-term sustained yield. A THP which relies upon and is found to be consistent with an approved SYP shall be deemed adequate to achieve MSP.
(c) In a THP, or NTMP, MSP is achieved by:
(1) For evenage management, meeting the minimum stand age standards of 14 CCR § 913.1(a)(1), meeting minimum stocking and basal area standards for the selected silvicultural methods as contained in these rules only with group A species, and protecting the soil, air, fish and wildlife, water resources and other public trust resources through the application of these rules; or
(2) For unevenaged management, complying with the seed tree retention standards pursuant to 14 CCR § 913.1(c)(1)(A) [933.1(c)(1)(A), 953.1(c)(1)(A)] or 913.2(b)(6) [933.2(b)(6), 953.2(b)(6)], meeting minimum stocking and basal area standards for the selected silvicultural methods as contained in these rules only with group A species, and protecting the soil, air, fish and wildlife, water resources and other public trust resources through the application of these rules.

(3) For intermediate treatments and special prescriptions, complying with the stocking requirements of the individual treatment or prescription.
(4) Timberland ownerships totaling 50,000 acres or less may use subsection (c) to show MSP.
(5) Timberland ownerships of 50,000 acres or more may use subsection (c) through December 31, 1999. Thereafter they may use subsection (c) if an SYP or demonstration of achievement of MSP pursuant to 14 CCR § 913.11(a) [933.11(a), 953.11(a)] has been filed with the department and has not been returned unfiled or approved.
(6) For scattered parcels on timberland ownerships of 50,000 acres or more, subsection (c) may be used to show MSP.

CEQA Context

The Department recognizes that in approving a THP it must meet the requirements of CEQA including, addressing potential impacts from significant GHG emissions. However, there is little guidance in CEQA or the FPRS on how the Department should address the GHG question. The OPR Technical Advisory on CEQA and Climate Change provides only "informal guidance" to lead agencies in addressing climate change in CEQA documents. The Technical Advisory is neither state law nor regulation and, as such, lead agencies are free to meet their responsibilities for addressing a project's GHG emissions under CEQA in a number of ways. In 2010, once OPR and the Natural Resources Agency have adopt regulations, in compliance with SB 97, lead agencies may have more specific guidance on how to proceed in meeting their CEQA responsibilities in addressing GHG emissions.

The Technical Advisory does recommend that lead agencies,

1) determine whether a project will emit GHGs,
2) determine if those emissions are individually or cumulatively significant, and
3) identify ways to mitigate emissions that have a significant effect.

As with all other resource areas, CEQA does not require lead agencies to eliminate effects associated with GHG emissions; only to mitigate emission impacts to a level of less than significant.

The Department has met its lead agency responsibilities through its review of the THP, review of the LTSY for the ownerships, reviewing and commenting on public areas of concern in this Official Response, review of pertinent literature and concluding that GHG emissions from this project will have a less than significant effect on the environment and that no mitigation is required.

AB32 Context

Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006, was signed into law by Governor Schwarzenegger and represents a comprehensive approach to address climate change. AB32 establishes a statewide goal to reduce greenhouse gas emissions to 1990 levels by 2020. The California Resources Air Board (ARB) is the lead agency for implementing AB32.

The scoping plan adopted by the ARB in December of 2008 establishes a general roadmap that

California will take to achieve the 2020 goals. Targets for the Forestry Sector were established under the "Sustainable Forests" section of the Scoping Plan. The "Sustainable Forest" element was recognized as a carbon sink based on the current carbon inventory for the Forest Sector and sequestration benefits attributable to forest. Specific recommendations for the sector included:

- Maintaining the current 5 $MMTCO_2E$ reduction target through 2020 by ensuring that current carbon stock is not diminished over time.
- Monitoring of carbon sequestered
- Improving greenhouse gas inventories.
- Determining actions needed to meet the 2020 targets.
- Adaptation
- Focusing on sustainable land-use activities.

Wildfire threat and loss to conversions are recognized as potential threats to the Forest Sector in relation to achieving sector goals.

Monitoring data from the United State Forest Service's report entitled "California's Forest Resources, 2001-2005 Five Year Forest Inventory Report (FIA)" (Christensen, et al., 2008 PNW-GTR-763) provide the most current information on inventory trends for California Timberlands. Current Gross Growth on all ownership groups indicates that inventory is increasing across all ownership groups at approximately 0.8% per year in terms of cubic feet of inventory.

The inventory is reported by various sectors including National Forests, State and Local Government, Corporate Private, and non corporate private. With the exception of the Corporate Private the other three reporting categories are showing net increases in inventory. For the non-corporate private sector in the inventory, the data indicate that current annual growth for the period is increasing at approximately 0.3 percent per year. For the corporate sector, growth is balanced.

The monitoring trends reflected in the report indicate that non-corporate private timberlands for the period reported are continuing to build inventory under past practices and it is reasonable to assume that these trends will continue. Adverse impacts associated with harvesting on these timberlands are not anticipated. However, given the error bar around the estimates of growth continued monitoring at the FIA level will be necessary to track performance of the non-corporate sector. Monitoring at the state level to track performance of non-corporate landowners is the most appropriate scale. Monitoring is not appropriate at the individual THP level as it is unreasonable to expect that speculative estimation by plan submitters would provide a reasonable mechanism. As long as the monitoring determines maintenance or increases in carbon stock, timber harvesting activities in this landowner category will not have an adverse impact on GHG targets for the sector.

For the Corporate category, the FIA data indicate that growth and harvest are essentially balanced. Again, the error bars around this estimate are large. Since the landowners represented in this FIA category also comprise the landowners in the state with greater than 50,000 acres, the Department has evaluated the inventory trends reported in the Long-Term Sustained Yield Documents the Department has on file (see Table 1 below). These documents indicate that for most landowners and the management regimes selected, inventory is increasing and will support the 2020 Scoping Plan Goals. Since the inventory estimates for these landowners are based on a

significantly greater number of inventory plots, it is likely that the net growth estimates for the individual landowners is more accurate than the FIA estimate. Monitoring and tracking for this landowner group will be important as the acreage in this category will be most likely represent the component of timber management activities which will impact either positively or negatively impact inventories. This ownership category is also most closely associated with milling capacity and would be most likely to benefit from carbon pools associated with wood products in-use, substitution, and products in landfills. As such, the Department will request that landowners with 50,000 acres or more address the air quality GHG impacts associated with their selected management regime. Preferably this analysis would be tied to the LTSY demonstration at the ownership level, evaluate inventory trends, assess impacts of the management regime on appropriate carbon pools, and address wood product in-use pools, landfilled carbon, and substitution based on the types of manufactured products. Within this context, if the GHG analysis is included as part of the overall management regime for the ownership, individual THPs that are consistent with the management regime described in the LTSY documents will not be required to specifically address GHG relationships other than to demonstrate consistency with the management regime. In this THP, SPI has directly addressed GHG in an analysis included in the plan.

Additionally, conversions represent a specific type of individual project that has recognized GHG impacts and is not tied to an overarching management regime. As such conversions will require GHG accounting to analyze and mitigate the direct and indirect impacts associated with these types of projects.

Negative impacts associated with land use change

The State has recognized the importance of forestland for the benefit of many resources. Even before carbon sequestration was in the national spotlight it was acknowledged that the most significant threat to resource values associated with forest lands is when those forestlands are converted to non-timberland uses. In the California Timberland Productivity Act of 1982 (Government Code 51101) the legislature found and declared the following:

> " (a) The forest resources and timberlands of this state, together with the forest products industry, contribute substantially to the health and stability of the state's economy and environment by providing high quality timber, employment opportunities, regional economic vitality, resource protection, and aesthetic enjoyment.
> (b) The state's increasing population threatens to erode the timberland base and diminish forest resource productivity through pressures to divert timberland to urban and other uses and through pressures to restrict or prohibit timber operations when viewed as being in conflict with non-timberland uses.
> (c) A continued and predictable commitment of timberland, and of investment capital, for the growing and harvesting of timber are necessary to ensure the long-term productivity of the forest resource, the long-term economic viability of the forest products industry, and long-term stability of local resource-based economies."

As part of the original 1976 Act and consistent with the above intent, a Timberland Preserve Zone

(TPZ) designation was created for the zoning of land used for growing hand harvesting timber. Renamed Timber Production Zone under the California Timberland Productivity Act of 1982 the compatible uses permitted on these lands were restricted to (Government Code 51104[h]):

(1) Management for watershed.
(2) Management for fish and wildlife habitat or hunting and fishing.
(3) A use integrally related to the growing, harvesting and processing of forest products, including but not limited to roads, log landings, and log storage areas.
(4) The erection, construction, alteration, or maintenance of gas, electric, water, or communication transmission facilities.
(5) Grazing.
(6) A residence or other structure necessary for the management of land zoned as timberland production."

For the most part the lands within the SPI ownership are zoned TPZ. Changing the zoning is a complicated and costly process which includes written notice to the appropriate board of supervisors (county or city and county) or city council, a public hearing, majority vote (or four-fifths vote for immediate rezoning) of the Board or Council (Government Code 51120-51121, 51133). Except in the case of immediate rezoning the new zone becomes effective 10 years from the date of the majority vote. For immediate rezoning a recoupment fee is imposed that is the difference between the current tax levy for TPZ and new zoning multiplied by a factor (13.97164 – Government Code 51142). Without a change in zoning, the lands can only be used for timber production and the compatible uses described above. TPZ lands can not be converted to non-forest use without changing the zoning.

The Department recognizes the potential negative impacts of conversion and has developed programs and policies which maintain working forested landscapes. State policy as reflected in the Timberland Productivity Act also establishes maintaining forested lands in timber productivity. However, none of these plans proposes a change in land use. Harvested areas will be restocked and conversion is not being proposed.

The zoning of these lands as TPZ and the implementation of growth and yield documents that drive management indicate a long-term commitment to maintain forests on these lands.

Adverse impacts attributable to forest management on carbon storage and sequestration rates.

Consistent with the Timberland Productivity Act, the Forest Practice Act and Forest Practice Rules, the acreage proposed for harvest by large landowners under individual Timber Harvesting Plans is generally zoned for timber production, and the timber operations comply with the provisions of the Forest Practice Act, California Environmental Quality Act, California Endangered Species Act, Timberland Productivity Act and other applicable statutes.

In addition, because for landowners who own more than 50,000 acres of timberland, the Forest Practice regulations require demonstration of Maximum Sustained Productivity for their ownership which discloses for their desired management regime the inventory, growth and harvest for the

ownership. This requires modeling to develop a Long Term Sustained Yield for the ownership. The LTSY estimates the inventory at the end of a 100 year planning period and predicts growth on that inventory. THPs submitted for the ownership are expected to be consistent with the management regime which supported the modeling for the LTSY calculation.

From a carbon sequestration perspective, the LTSY calculations for an ownership are indicative of carbon stock (timber inventory) and rate of sequestration (growth). The Department's review of approved LTSY documents for the larger landowners in the state indicates that at the end of the 100-year planning horizon required in the Forest Practice Rules that the total inventory (carbon stock) and growth (sequestration rate) will exceed existing inventory and growth levels. In addition, over the 100 year period analyzed wood products represented through projected harvest levels will result in sequestration of wood products in use as well as wood products in landfills. In combination with substitution benefits when comparing wood products to other substitute building materials, greenhouse benefits attributable to the management regime selected by larger landowners do not in the Department's judgment represent an adverse impact but rather will benefit both carbon storage and sequestration. As such additional mitigations to address the impacts of this plan on climate change have not been determined to be necessary.

The Department recognizes that the forests of California are an important component of the State's efforts under AB 32 to mitigate climate change impacts of CO_2 relative to climate change. The 2003 Forest and Range Assessment (FRAP, 2003) establishes a goal to "acquire and develop data and information on global climate change for use in reducing or mitigating the production of greenhouse gasses including net reductions through the management of natural forest reservoirs (paraphrased fro Cal. Public Resources code Section 25730, climate Change Inventory and Information)." In cooperation with the Resources Agency, Board of Forestry and Fire Protection, Air Resources Control Board, California Environment Protection Agency, California Energy Commission, Bio-energy Interagency Working Group, the United States Forest Service, Biomass Working Group and numerous other local, state and federal entities, have been working to improve working knowledge of the role of California's forests.

Forest land management will play a major role in climate change. The forests of California will both effect and be affected by climate change. The California Forest Resources, 2001-2005 Five Year Inventory and Analysis Report (Christensen, et al., 2008) shows an inventory of 2,184 million bone-dry tons of above ground biomass representing an estimated mass of 1,102 million bone-dry tons of stored carbon for all forest landowners in California. The 2003 FRAP Assessment estimated that the annual growth on timberlands was 70 per cent of potential growth capability and also recognize a declining trend in harvest. The declining trend in harvest is also noted in the Forest Service's Forest Resources Report (Christensen, et al., 2008). They noted this trend is expected to continue.

Based on summaries of the 2008 Forest Inventory Assessment (Christensen, et al., 2008) for California's forests, recent inventory data nor harvest trends indicate that disturbance from logging when measured over a long period needs to be reduced. Growth on public ownerships and non-corporate private ownerships is greater than removals attributable to harvesting and mortality. For corporate ownerships, growth and harvests are essentially balanced in the FIA data.

The Department also reviewed LTSY projections for the 2020 and 2050 periods for these landowners and it indicated that inventories are expected to increase. Given the LTSY projections for the larger landowners, the trend indicated in the FIA data relative to increases in growing stock volume and growth through 2050 is likely to continue.

The Department recognizes that growth on California's forested landscapes remain below the potential productivity (FRAP 2003). Forest management through aggressive reforestation, enhancement of conifer site occupancy, genetic improvement, thinning, etc. can and will improve productivity on managed lands while balancing other resource values and providing positive benefit from a climate perspective. This positive benefit will come from increased inventory (carbon stock), increased growth (sequestration) and sequestration, storage in wood products and landfills, as well as substitution benefits attributable to forest management life cycle analyses.

Based on these various inventories and projections, the Department does not anticipate a significant impact on carbon sequestration attributable to forest management. The Department recognizes that the inventories in the current LTSY projections for the larger landowners reflect bolewood measured in millions of board feet. Impacts on other carbon pools are not reflected in either these estimates or the FIA estimates. It is reasonable to conclude that forest management practices that lead to increases in bolewood volume will also have positive benefit to other forest, in-use, landfilled, and substitution relationships. These aspects are discussed elsewhere.

In summary, an extensive regulatory framework developed under the authorities granted to the Board of Forestry and Fire Protection has been developed that regulates harvesting activities, establishes protection standards for multiple resource values, addresses conservation standards to insure baseline forest productivity, and addresses long term sustainability.
One of the activities recognized as having adverse impacts to CO_2 sequestration potential of California's forests is deforestation through conversion. The Department recognizes the potential negative impacts of deforestation and has developed programs and policies which maintain working forested landscapes. State policy as reflected in the Timberland Productivity Act also establishes maintaining forested lands in timber productivity. CAL FIRE also participated in the development of a Conservation protocol for forest projects. Consistent with the Timberland Productivity Act, the Forest Practice Act and Forest Practice Rules, the management activities proposed under the Whitmore Grade THP do not represent a change in land-use. The acreage proposed for harvest is zoned for timber production, and the timber operations comply with the provisions of the Forest Practice Act, California Environmental Quality Act, California Endangered Species Act, Timberland Productivity Act and other applicable statutes. The plan has also been found to be in conformance with applicable Forest Practice Regulations.

In addition, because Sierra Pacific Industries owns more than 50,000 acres of timberland, the company has prepared an Option "a" for their ownership which discloses for their desired management regime the inventory, growth and harvest for the ownership. This Option "a" is included by reference as part of the Whitmore Grade THP. From a carbon sequestration perspective, the SPI Option "a" indicates that at the end of the 100-year planning horizon required in the Forest Practice Rules that the total inventory (carbon stock) and growth (sequestration rate) will exceed existing inventory and growth levels. In addition, over the 100 year period analyzed wood products represented through projected harvest levels will result in sequestration of wood products in use as well as wood products in landfills. In combination with substitution benefits

when comparing wood products to other substitute building materials, greenhouse benefits attributable to the management regime selected by SPI do not in the Department's judgment represent an adverse impact but rather will benefit both carbon storage and sequestration. As such additional mitigations to address the impacts of this plan on climate change have not been determined to be necessary.

For California's forests, neither recent inventory data nor harvest trends indicate that disturbance from logging, when measured over a long period, needs to be reduced. Harvest levels are below growth for all sectors. Given the LTSY projections for the larger landowners this trend will continue...In addition the Department recognizes that growth on California's forested landscapes remain below the potential productivity. Forest management through aggressive reforestation, enhancement of conifer site occupancy, genetic improvement, thinning, etc. can and will improve productivity on managed lands while balancing other resource values and providing positive benefit from a climate perspective. This positive benefit will come from increased inventory (carbon stock), increased growth (sequestration) and sequestration and substitution benefits attributable to forest management life cycle analyses.

2. Concern: It was stated that studies show that logging can remove ninety-five percent of the non-soil carbon stored in a forest ecosystem and half of this is lost to the atmosphere in the first year (Janisch and Harmon 2002). Skog and Nicholson (2000) reconstructed the fate of forest carbon in the United States from 1910 to 2000. They found that 71 % of the carbon harvested during that period was released into the atmosphere while only 17% was stored in wood products and the remaining 12% was added to landfills.
After a human disturbance such as a clear cut harvest, ecosystems are a source of carbon to the atmosphere because of the decomposition of large woody debris and other forms of detritus. Later in stand development, as tree bole volume rapidly accumulates, forest ecosystems are strong carbon sinks.
Studies of various ecosystems ranging from the Douglas-fir and hemlock communities common to the Pacific Northwest to forests of northwestern Russia characterized by southern taiga vegetation have all resulted in the same conclusion clear-cutting (or associated techniques such as visual retention silviculture) does not increase or maximize stored forest carbon or sequestration ability (e.g., Harmon et al. 1990; Krankina et al. 2004). Depro et al. (2008) modeled forests of all types in all regions of the United States. They found that [i]n contrast with the no-harvest scenario, increasing the baseline harvest levels to pre-198levels leads to a significant decrease in the carbon sequestered in public forests. Our estimates suggest losses ranging from 27 to 35 MMTC per year through carbon storage in wood and paper products. A recent EIR conducted for California's Jackson State Forest pointed out that even-aged management (i.e., clear-cutting) is not the appropriate tool for dealing with climate change
Brown et al. (2004a) estimated the carbon benefits of an uneven-aged

management, group selection harvest regime as compared to an even-aged management, clear-cut harvest regime on JDSF. They found that use of group selection (1.5-acre group size) instead of clear-cuts (20 acres in size) resulted in an increase in carbon storage of 14-27 tons per hectare (5.7-10.tons/acre) over a 90-year rotation. In general, harvesting trees greatly impacts climate change; clear-cutting is particularly detrimental because it releases more carbon than any other disturbance including fire (Harmon 2007). When describing harvesting and clear-cutting, Harmon (2007) states the result is that harvesting forests generally reduces carbon stores and results in a net release of carbon to the atmosphere. The impacts of carbon release also occur from logging forests that have previously been logged. Mackey et al (2008) state: The remaining intact natural forests constitute a significant standing stock of carbon that should be protected from carbon-emitting land-use activities. There is substantial potential for carbon sequestration in forest areas that have been logged commercially, if allowed to re-grow undisturbed by further intensive human land-use activities. There are important distinctions between the carbon dynamics of natural forests and industrialized forests, especially monoculture plantations. Most of the biomass carbon in natural forests is stored in the larger, older trees; however, commercial logging removes most of these trees, leaving stands with much younger average ages. As a result, logged forests have a significantly reduced (more than 4 percent) long-term average standing stock of biomass carbon compared with an unlogged forest (Roxburgh et al. 2006; Brown et al. 1997). In a study of temperate forests in Australia, Roxburgh et al (2006) found that forests recovering from prior logging have the potential to store significant amounts of carbon, with current biomass stocks estimated to be approximately 60% of their predicted carrying capacity, a value similar to those reported for northern temperate forests. Brown et al (1997) conducted a study with similar objectives that assessed the sequestration potential for two eastern USA hardwood forests (oak-hickory and maple-beech-birch) recovering from past disturbance by estimating their above-ground biomass density and comparing the results with undisturbed forests considered to be at maximum potential carbon stock capacity. Roxburgh et al. (2006) explain their findings. Brown, Schroeder Birdsey (1997) demonstrated that the managed eastern hardwood forests had much lower above-ground biomass density than the old-growth forests, and generally less than 50% of the predicted CCC (carbon carrying capacity) of approximately 250tC ha-1, suggesting that through recovery and regrowth these forests have the potential to accumulate significant quantities of additional biomass, and thus sequester atmospheric carbon into the future. Although maximum CCC in the eastern USA forests is less than that reported here, the relative difference between managed and mature forests is approximately the same, at 50-60% of predicted CCC. Industrialized forests have all of

their above-ground biomass removed regularly, on a rotation ranging between every 10 to 70 years (Varmola and Delungo 2003). Thus, the carbon stock on a commercially logged forest will always be significantly less than the carbon stock of a natural, undisturbed forest (Mackey et al. 2008). Unfortunately, specific examples of the climate costs associated with clear-cutting are plentiful. Using a model that took into account the prevalence of clear-cutting practices from 1972-1991, researchers found that forests in the Pacific Northwest released 11.8 x 1012 g C/year (Cohen et al. 1996). From this finding they calculated that even though forests in this region represented only 0.25% of the 4.1 billion hectares of forest on Earth, they were the source of 1.31 % of the total land-use related carbon release in the world (Cohen et al. 1996; Dixon et al. 1994). They state: Although replacing older forests with more vigorous young forest can increase sequestration by live carbon pools, decomposition of the large detrital pools after harvest greatly offsets gains in biomass by living pools for an extended period of time (Cohen et al. 1996).

One study speaks volumes regarding conversion of forests to plantations - the conversion to plantations of over 12 million acres of old-growth forests in Western Oregon and Washington in the past 10years has resulted in the release of 1.5 to 1.8 billion MG[6] of carbon into the atmosphere (Harmon et al. 1990). Intensification of forestry activities is often promoted on the basis that young, actively growing trees will sequester carbon more rapidly than old-growth forests in which respiration may equal or even exceed photosynthesis (Birdsey 1992). Replacement of old forests with plantations is a perverse incentive of the Kyoto Protocol (Brown 1998; Dudley 1998). Simplistic carbon accounting, encouraged by the protocol, ignores the tremendous releases of carbon that occur when forests are disturbed by logging and related activities such as site preparation and vegetation management (Perry 1994; Schulze et al. 2000). It ignores the fate of woody debris and soil organic carbon during forest conversion (Cooper 1983; German Advisory Council on Global Change 1998). Typically, respiration from the decomposition of dead biomass in logged forests exceeds net primary production of the regrowth (Schulze et al. 2000). Considerable time is required - often hundreds of years - for regenerating forests to accumulate the carbon stocks characteristic of primary forests (Harmon et al. 1990). Over several rotations of growth and harvest, the mean carbon pool of intensively managed forests is only about 30% that of primary forests (Cooper 1983). From the standpoint of maintaining biodiversity during climate change, conversion of natural forests to plantations cannot be justified. Tree plantations around the world, especially exotic monocultures, have less biodiversity than natural forests in the same regions (Hunter 1990; Noss Cooperrider 1994; Perry 1994). Plantations are often markedly less resistant to disturbances such as fire and

more subject to pest outbreaks than natural forests (Schowalter 1989; Perry 1994). Pest outbreaks could increase in severity or change in distribution with changing climate (Williams Liebhold 1995), amplifying the vulnerability of plantations. Noss (2001) also notes that clear-cutting, especially as practiced by SPI, causes significant habitat fragmentation, which has climate impacts of its own. Fragmentation may threaten biodiversity during climate change through several mechanisms, most notably edge effects and isolation of habitat patches. Intact forests maintain a microclimate that is often appreciably different from that in large openings. When a forest is fragmented by logging or other disturbance, sunlight and wind penetrate from forest edges and create strong microclimatic gradients up to several hundred meters wide, although they may vary in severity and depth among regions and forest types (Ranney et al. 1981; Franklin Forman 1987; Chen Franklin 1990; Laurance 1991, 2000; Chen et al. 1992; Baker Dillon 2000). With progressive fragmentation of a landscape, the ratio of edge to interior habitat increases, until the inertia characteristic of mature forests is broken. Fragmented forests will-likely demonstrate less resistance and resilience to climate change than intact forests. Another potentially serious impact of fragmentation is its likely effect on species migration. By increasing the isolation of habitats, fragmentation is expected to interfere with the ability of species to track shifting climatic conditions over space and time. Weedy species, including many exotics, with high dispersal capacities may prosper under such conditions, whereas species with poor mobility or sensitive to dispersal barriers will fare poorly. If the Whitmore Grade THP is to meet its CEQA obligations, it must assess the significant contribution of logging, and especially clear-cutting, to carbon emissions. This is especially true in light of the widespread clear-cutting operations that SPI has already completed, as well as SPI's intent to continue massive and widespread clear-cutting throughout the state of California. Again, as stated by one forest scientist, clear cutting in particular removes more carbon from the forest than any other disturbance (including fire). The result is that harvesting forests generally reduces carbon stores and results in a net release of carbon to the atmosphere.(Harmon 2007). Over half of the carbon stored in United States forests is in the forest floor and soils (Turner et al 1995). The carbon stored in forest soils includes two pools; mineral soils and soil organic matter (Jandl et al. 2007). Much of the carbon stored in mineral soils is considered to be quite stable, and does not generally change dramatically in response to land management activities such as logging (Kimmins 1997; Johnson 1992; Heath and Smith 2000). However, the carbon contained in soil organic matter (which supports vegetation growth) does change in response to land management and is often reduced through logging (Jandl et al2007; Birdsey and Heath 1995; Harmon et al. 1990). This is because

harvesting removes biomass, disturbs the soil and changes the microclimate all at the same time. It is possible that post-harvest soil carbon losses may exceed carbon gains in the aboveground biomass. For example, Birdsey and Heath (1995) created a representative model for all forest land classes in all 50 states. They highlight the relative contribution of forest floor and soil carbon to the estimated annual increases in carbon storage and state that: Nationally about 2/3 of the historical and projected positive flux is carbon buildup in the soil and forest floor. A search of the literature indicated that a major forest disturbance such as a clearcut harvest, can increase coarse litter and oxidation of soil organic matter. The balance of these 2 processes can result in a net loss of 20% of the initial carbon over a 10-15 year period following harvest (Pastor and Post 1986, Woddwell et al. 1984).

Citing literature from geographic regions throughout the U.S. and the world, and considering many different types of tree species and communities, Jandl et al. (2007) explored the way in which forest management can affect soil carbon sequestration. The authors summarize the science showing the impact that logging can have on soil carbon Other researchers report large soil C losses after harvesting. Measurement of net ecosystem C exchange showed that for at least 14 years after logging, regenerating forests remained net sources of C02 owing to increased rates of soil respiration (Olsson et al., 1996; Schulze et al., 1999; Yanai et al., 2003). Reductions in soil C stocks over 20 years following clear cuts can range between 5 and 20 t C/ha and are therefore significant compared to the gain of C in biomass of the maturing forest (Pennock and van Kessel, 1997). In their research to develop a model to quantify carbon in various types of U.S. forests, Smith and Heath (2002) found that by reducing litter input and increasing decomposition, clear-cut logging reduces forest floor carbon considerably. Decreases of 50% of forest floor mass have been shown for the first 15 years after logging in northern hardwoods (Covington 1981). Covington (1981) states that the initial decrease in forest floor mass is due to lower leaf and wood litter fall and to more rapid decay resulting from higher temperature, moisture content, and nutrient levels and to early successional litter being more easily decomposed. Because the debris left behind after logging - branches, tops, and brush - continues to decay for many years after the disturbance, recently logged sites, even those that are replanted, continue to release carbon dioxide into the atmosphere for decades (Buchmann and Schulze 1999; Bergeron et al. 2007).

Trees planted after harvest often emit carbon for years, despite the rapid growth rate of young trees. This is due to the fact that microbes in the forest soil, which release CO_2 as they break down dead branches and roots, work more quickly after a stand is logged. Studies have shown that a replanted clear-cut gives off more CO_2 than it absorbs for as long as 20 years. Reforestation - the planting of new

trees on a denuded forest site - theoretically helps to offset these releases. But, the decay process releases more carbon into the atmosphere than tiny saplings remove, leaving cutover forest lands as net sources of carbon dioxide for several decades (Lecomte et al. 2006; Fredeen et al. 2005; Turner et al. 1995; Harmon et al. 1990). Cutover lands emit significant amounts of carbon, especially when compared to uncut forests (Bergeron et al. 2008). As discussed earlier, forests are carbon banks, storing large amounts of carbon for long periods of time. Old growth forests have an especially vast amount of live vegetation including huge trees, large downed logs, a healthy understory and a rich ground layer. Each of these elements stores considerable amounts of carbon and so it follows that ancient forests are the banks holding the most carbon. A report from the IPCC has echoed this sentiment pointing out that the best way to preserve the carbon stored in a forest is to preserve the forest itself. The theoretical maximum carbon storage (saturation) in a forested landscape is attained when all stands are in old-growth state (Nabuurs et al. 2007).Studies about the contributions old growth forests make to atmospheric carbon removal and storage and the environmental benefits they provide (i.e., habitat) also highlight the ecosystem services and ecological values that are being lost when old growth forests are logged and replaced with plantation forests. Some industry advocates like to argue that old-growth forests are carbon neutral- that is, they no longer remove carbon from the atmosphere at significant rates In addition, there is a widespread and misguided belief that logging or clearing older forests and replacing them with fast-growing younger trees will benefit the climate by sequestering atmospheric carbon dioxide. Such claims are not only factually wrong - older forests continue to remove carbon from the atmosphere at considerable rates - they are also misleading in that they disregard the amount of carbon already stored in the forest ecosystem. Luyssaert et al (2008) state: Our results demonstrate that old-growth forests can continue to accumulate carbon, contrary to the long-standing view that they are carbon neutral. This is why short rotation clear-cut forestry (as in the case of this proposed project) is especially problematic; it prevents vast amounts of trees from getting older, let alone from reaching the old growth stage which science shows is best in terms of its implications for carbon uptake and climate change, not to mention overall ecological benefits. In terms of the actual loss of stored carbon, when a forest is logged, some of its carbon may be stored in wood products. However, the evidence shows that this is not what happens to a large percentage of carbon. Instead, large quantities of carbon dioxide are released to the atmosphere immediately through the disturbance of forest soils, and over time through the decomposition of leaves, branches, and other detritus of timber production. One study found that even when storage of carbon in timber products is considered, the conversion of 5 million hectares of

mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon in the atmosphere (Harmon et al. 1990). Thus, middle-aged forests may remove carbon dioxide from the atmosphere at higher rates than ancient forests, but they store considerably less carbon overall. Using the bank metaphor ancient forests have much more carbon in the bank, even though deposits may - in certain regions - slow down a bit. Younger forests make rapid deposits, but they are being made in a carbon account that has been emptied. Generally, it takes a long time for a cutover forest to become a net carbon sink - that is, a site that removes from the atmosphere more carbon than it releases (Janisch and Harmon 2002; Chen et al. 2004). In a study of mixed conifer forests in Washington, Janisch and Harmon (2002) state: Given these results, at a rotation age of 80 years, a regenerating stand would store 172 Mg C ha live wood (mean) and 28 Mg C ha CWD. This is 193 Mg C ha^{-1} below old-growth rates (Lo + mean old-growth CWD). Given a rotation age of 60 years, a regenerating stand would store a mean of 125 Mg C ha^{-1} in live wood and 21 Mg C ha^{-1} CWD. This amounts to a reduction of 247 Mg C ha relative to old-growth stands, consistent with past modeled conversions of old-growth forests to regenerating forests (Harmon et al. 1990). Maximum C stores (live and dead) of 393 Mg C ha were reached about 200 years after disturbance. Some forests take even longer than 50 years to make the transition (Janisch and Harmon 2002). Once logged, these forests remain net sources of carbon into the atmosphere for a half-century. We recognize this timber harvest plan does not include plans to harvest extensive amounts of old-growth. However, it does include plans to clear cut middle-aged forests, and likely some old trees that still remain from previous cutting. Clear-cutting large swaths of middle-aged trees ensures that these forested areas will not mature into old-growth depriving us of opportunities for increased carbon sequestration and denying plants, animals and humans the other benefits associated with mature forests. Old-growth forests store considerably more carbon-up to four times as much-than young and middle-aged forests (Law et al. 2003; Pregitzer and Euskirchen 2004; Fredeen et al. 2005; Smith et al. 2004b). Middle-aged forests may remove carbon dioxide from the atmosphere at higher rates than ancient forests, but they store considerably less carbon overall (Pregitzer and Euskirchen 2004; Seely et al. 2002; Fredeen et al. 2005). After modeling the response to various management and silvicultural scenarios of different species commonly found in forests of British Columbia, Seely et al. (2002) reported that total ecosystem carbon increased with rotation length regardless of species, and this was attributable largely to changes in the live biomass pool. Specifically they found that 50 year spruce rotations stored 150 Mg ha^{-1} of carbon whereas spruce with a rotation of 200 years stored about 250 Mg ha^{-1}. Pine with 40 year rotations stored 150 Mg ha^{-1} of carbon while pine with rotation lengths of 150 years stored above 250

Mg ha^{-1} of carbon. Aspen with a rotation length of 40 years stored 175 Mg ha while 80- 100 year rotation stored 225 Mg ha^{-1} of carbon. Fredeen et al (2005) found similar results and reported that mean total C stocks for old-growth stands ranged from 423 Mg C ha^{-1} (coarse) to 324 Mg C ha^{-1} (fine), intermediate between Pacific Northwest temperate forests and upland boreal forests. Total C was lower in second growth stands because of lower tree (mostly large tree stem), forest floor, and woody debris C stocks. They estimate that harvesting of old-growth forests in sub-boreal British Columbia lowers total C stocks by 54%-41%. (Fredeen et al. 2005). Smith et al. (2004b) estimated that young forests contain less than a quarter of the carbon stored in ancient forests of the Pacific Northwest. Other regions, including the southeast and northern Lake states, showed similar trends. In the northeast, five-year-old stands of birch store 52 tons of carbon per hectare while 125-year-old stands store 219 tons (Smith et al. 2006). The following chart shows the difference in carbon stores between an old-growth forest ecosystem and 60-year-old forest. Much of the difference-roughly 350 Mg C/hectare-is released through logging (Harmon et al. 1990). The reason old-growth forests store more carbon than younger forests is that they have had more time to grow larger trees and develop a complex forest floor. The following chart shows the carbon storage within the components of a young forest and ancient forest ecosystem. Clearly, it is not only older trees that hold large amounts of carbon; forest floors in older forests contain significantly more carbon than forest floors of cutover forests (Lecomte et al. 2006; Fredeen et al. 2005; Harmon et al. 1990). For example, decomposition of trees can take decades, therefore the CO_2 released from the decomposition of dead wood adds to the atmospheric carbon pool over decades, whereas natural regeneration or in-growth occurs on a much shorter timescale. For this reason, old-growth forest stands with tree losses do not necessarily become carbon sources, as has been observed in even-aged plantations (that is, where trees are all of the same age) (Luyssaert et al. 2008). Old forests increase the amount of carbon that is placed into long-term storage in stable forest soils; this carbon is lost through the soil disturbance associated with logging. (Harmon et al. 1990). This can have serious implications for sequestration capabilities as we see from conclusions made by Jandl et al. (2007)What is beyond dispute is that the formation of a stable soil [carbon] pool requires time. Avoiding soil disturbances is important for the formation of ... crucial elements in the process of [carbon] soil sequestration.

In our model we find that old-growth forests accumulate 0.4+/- 0.1 tC ha^{-1} yr^{-1} in their stem biomass and 0.7+/-0.2 tC ha^{-1} yr^{-1} in coarse woody debris, which implies that about 1.3+/-0.8 tC ha^{-1} yr^{-1} of the sequestered carbon is contained in roots and soil organic matter. Jandl et al. (2007) states that forest ecosytems store more than 80% of all terrestrial aboveground C and more than 70% of all soil organic

C (Batjes, 1996; Jobbagy and Jackson, 2000; Six et al., 2002a).The fact that the majority of sequestered carbon is found in roots and organic soil is significant given that logging, specifically clear-cutting, results in the loss of large amounts of soil and therefore, forest floor carbon. This loss is not only due to the direct impacts of logging, but also as a result of the continued erosion and soil degradation that often comes with logging. Numerous studies have shown that old-growth forests continue to sequester carbon from the atmosphere (Desai et al. 2005; Law et al. 2003; Chen et al. 2004; Field and Kaduk 2004; Paw U et al. 2004; Harmon et al. 2004; Grier and Logan 1977; Knohl et al. 2003). Old-growth Douglas fir forests, for example, show remarkable sequestration of carbon, comparable to many younger forests (Paw U et al. 2004).While some regional variation exists, older forests continue to remove carbon at rates greater than or comparable to young forests (Chen et al. 2004; Paw U et al. 2004; VanTuyl et al. 2005). In the eastern Cascades, for example, forest productivity is highest in the region's oldest forests (Van Tuyl et al. 2005). In contrast, young forests release carbon into the atmosphere through the decay of slash left behind after logging (Law et al. 2003) As Chen et al. (2004) explains: The conversion of long-lived forests into young stands may change the system from a sink to a source of carbon for several decades because the lower leaf area in regenerating forests limits photosynthesis while the residual carbon in soils and woody debris contributes to respiration, whereas old-growth forests may continue to function as a net carbon sink in addition to their many other important ecosystem functions. Contrary to popular belief, young forests do not have the highest carbon sequestration rates or net ecosystem productivity. In fact, Law et al. (2003) examined the variation in productivity and sequestration according to stand age. Net ecosystem productivity was actually the lowest in the initiation stands (9-23 years), moderate in young stands (56-89 years), highest in mature stands (95-106 years) and trended downward in the oldest stands (190-216 years), but was still greater than the youngest stands (Figure 4). The following chart shows the difference in sequestration rates between various age-classes of forests Law et al. (2003) also found that the old stands had the highest level of carbon storage in live mass by age 200 and it did not decline after that (mean 17.6 kg Cm^{-2}). Overall ecosystem carbon storage increased rapidly until 150-200 years and did not decline in older stands (Law et al. 2003). It is true that the rate of carbon uptake by young trees in plantations and re-growth forests is high (Mackey et al. 2008). However, this carbon uptake over a rotation would not compensate for the amount of carbon presently stored in natural forests that would be lost if they were harvested (Harmon et al. 1990; Schulze et al. 2000). For example, Harmon et al. (1990) found that the conversion of 5 X 10^6 hectares of old growth conifer forest to younger plantations in western Oregon and Washington in the

last 100 years has added 1.5 X 10^9 to 1.8 X 10^9 megagrams of carbon to the atmosphere. In addition they found that there was 2.2 to 2.3 times as much storage in a 450 year old natural stand than in a 60-year old plantation and that carbon storage is reduced by 350-370 Mg of C per hectare as a result of conversion of old-growth to plantation. Even considering a long-term perspective, transforming old-growth forests into plantations results in the loss of up to 50% of total ecosystem carbon (Kurz et al. 1997). Luyssaert et al. (2008) report that:
In fact, young forests rather than old-growth forests are very often conspicuous sources of CO_2 because the creation of new forests (whether naturally or by humans) frequently follows disturbance to soil and the previous vegetation, resulting in a decomposition rate of coarse woody debris, litter and soil organic matter (measured as heterotrophic respiration) that exceeds the NPP (net primary production) of the regrowth. (Harmon et al. 1990; Janish and Harmon 2000; Wirth et al. 2002; Knohl et al. 2002; Kowalski, A. S. et al. 2004; Pregitzer and Euskirchen 2004; Irvine et al. 2007.) While younger trees grow and sequester carbon quickly, they have not had the time necessary to build up large stores of carbon like those found in forests that are allowed to reach greater maturity. Thus, logging a forest before it reaches old-growth status results in the long-term loss of stored carbon; effectively turning what would have continued to be a carbon sink (if the forest was left alone) into a carbon source, for at least a few decades (Harmon and Krankina, 2008, personal communication). This is because actively growing forests will accumulate carbon at a fairly fast rate and they will continue to do so unless they are harvested ((Harmon and Krankina, 2008, personal communication). This involves the actual loss of carbon that is released from logging and the potential for carbon storage that is lost by cutting down trees before they have reached their storage capacity.
Not only does it take time to establish elements in the soil needed for carbon sequestration, because of the time it takes trees to grow, it takes more than 150 years for a cutover forest to produce the amount of living and dead biomass that exists in an old-growth forest (Janisch and Harmon 2002). This is important information to consider in light of the fact that managed forests, logged at an 80-year rotation, store only half the carbon of old-growth forests (Janisch and Harmon 2002). A clear explanation for why clear-cutting and the replacement of forests with even-aged plantations are so detrimental is provided by Luyssaert et al. (2008): We speculate that when high above-ground biomass is reached, individual trees are lost because of lightning, insects, fungal attacks of the heartwood by wood-decomposers, or trees becoming unstable in strong wind because the roots can no longer anchor them. If old-growth forests reach high above-ground biomass and lose individuals owing to competition or small-scale disturbances, there is generally new recruitment or an

abundant second canopy layer waiting in the shade of the upper canopy to take over and maintain productivity. In reasonable agreement with our observations (Fig. 1b), self-thinning theory predicts that the ratio between heterotrophic respiration and NPP is constant and around 0.65 +/- 0.02 (indicating a carbon sink; Supplementary Fig. 4), as long as stand density is driven by small-scale, rather than stand-replacing, disturbances. Old stands, with sufficiently high densities (that is, through development of a multilayer canopy structure) are thus expected to maintain biomass accumulation for centuries. Hence, we postulate that biomass accumulation and decline are largely driven by stand structure. The authors conclude that forests continue to act as carbon sinks unless they suffer from a stand-replacing disturbance; clear-cutting middle aged trees as proposed in this project is clearly a stand-replacing anthropogenic activity. These results are specifically relevant to this timber harvest plan since Sierra Pacific Industries is proposing to clear-cut 172 acres of trees and will do so before the trees reach an age when they achieve the highest sequestration rates. Cutover lands emit significant amounts of carbon, especially when compared to uncut forests (Bergeron et al. 2007). By cutting trees down before they reach their highest level of productivity and sequestration capabilities, the industry is undermining state and global carbon sequestration goals and attempts to curb climate change.

In addition to the carbon deficit that logging results in, there are other impacts. Even careful commercial forestry operations in high conservation value forests impose substantial costs to other forest ecosystem services such as biodiversity conservation, watershed maintenance, recreation and other forest amenities (Harmon et al. 1990). The need for forest protection, specifically protection of older trees and forests in light of climate change is supported by recent science. Luyssaert et al. (2008) conclude that as long as stand density is driven by small-scale, rather than stand-replacing activities, forests will remain carbon sinks. They recommend the protection of these forests from anthropogenic disturbance, like the proposed timber harvest plan we are commenting on the present paper shows that old-growth forests are usually carbon sinks. Because old-growth forests steadily accumulate carbon for centuries, they contain vast quantities of it. They will lose much of this carbon to the atmosphere if they are disturbed, so carbon accounting rules for forests should give credit for leaving old-growth forest intact. The Whitmore Grade THP at issue here states that there is no late seral forest habitat in the THP areas because whatever patches of such forest may exist, they do not comprise 20 contiguous acres and thus need not be recognized. (e.g., pg. 40,97 "There are no late successional or old growth forest stands within the THP area...as defined by the Director and the State Board of Forestry"). Regardless, SPI has failed to identify the age, as well as the number of trees at

each age, for the trees present in the THP site. This failure prevents an accurate assessment of the carbon value of old trees, as well as the value of moderately aged trees - in other words, assessing carbon impacts involves much more than just stating whether late seral forest exists on the site of the THP - it involves providing an accurate assessment of all the trees on the THP site in terms of number and age class. Moreover, an even-aged SPI forest will forever lack older trees due to its rotation schedule, and CAL FIRE and SPI must consider that fact. Without such relevant information, there is inadequate information to make an informed decision as to the impacts of the THP on carbon emissions - [an agency] cannot discharge its obligation to disapprove plans that do not incorporate feasible measures to reduce the significant adverse effects of the plan on the environment if it is unable to identify those significant adverse impacts due to a lack of information. Sierra Club v. State Bd of Forestry, 7 Cal. 4th 1215, 1228 (Cal. 1994); Jd at 1236 (lead agency had an obligation imposed by CEQA to collect information regarding the presence of old-growth-dependent species on the site of the proposed timber harvest before approving THP); Friends of the Eel River v. Sonoma County Water Agency, 108 Cal. App. 4th 859,874 (Cal. App. 1st Dist. 2003) (An EIR must contain an accurate description of the project's environmental setting.). When the informational requirements of CEQA are not complied with, an agency has failed to proceed in a manner required by law. Lf the deficiencies in an EIR preclude[ ] informed decision making and public participation, the goals of CEQA are thwarted and a prejudicial abuse of discretion has occurred. San Joaquin Raptor Rescue Center v. County of Merced, 14Cal. App. 4th 645, 672 (Cal. App. 5th Dist. 2007). Advocates for increased logging and/or use of wood products often argue that increased harvesting will result in more carbon being stored in forest and wood products. This is misleading because after logging, only a small fraction of the carbon stored in forest ecosystems is turned into forest products like paper and lumber (Harmon et al. 1996). Their study states that despite the large mass of carbon (1,692 Tg) harvested in Oregon and Washington, only a small fraction (23%) is currently stored in forest products. The majority of forest carbon is left behind in the forest to decompose naturally, burned on site, or transported to a mill where it is burned for fuel. Each of these outcomes of logging results in the release of carbon into the atmosphere. Harmon et al. (1990) supported this with research showing that although the pool of forest products in use or in landfills will tend to increase as harvest levels increase, the majority of the harvest does not go into long term storage and the magnitude of this sink is not large relative to fossil emissions. Thus, industry advocates that argue that shorter rotations result in larger amounts of stored carbon in forest products fail to consider all of the facts. The carbon stored in forest products does not offset the losses in the forest itself because the forest ecosystem loses

carbon a lot faster than the amount gained by forest products (Harmon and Krankina, 2008, personal communication). For the small proportion of logged material that is turned into a product, science shows that the amount of carbon stored in wood products is quite small relative to the amount of carbon stored in forest ecosystems. Worldwide, forest ecosystems store 100 times more carbon than wood products (Nabuurs and Sikkema 2001). Because forest products continue to decay over time, the carbon stored in these products is slowly released into the atmosphere. The half-life of carbon stored in wood in single-family homes is estimated to be 100 years, meaning that half of the carbon stored in lumber is released in the first 100 years (Skog and Nicholson 2000). However, Harmon ct al. (1990) estimate a 2% annual replacement rate for wood products that are used in long-term storage. Other forest products have a much shorter half-life, and thus release their stored carbon more quickly. Pallets and sheet paper, for example, have a half-life of six years (Skog and Nicholson 2000). Other paper products have a half-life of only a year. In terms of storage of forest carbon, there is clearly no comparison between forest products and living material. Trees not only store carbon indefinitely, but they remove it from the atmosphere creating a negative net emission of carbon. Therefore, it is difficult to demonstrate, as industry would like us to believe, that the carbon in wood-based products will remain in the terrestrial biosphere carbon reservoir for a longer period than it would have if it had remained in an unlogged natural forest. Sierra Pacific Industries released a report in 2007 that concluded that [w]hen accounting for carbon stored in wood products and harvest residues, intensively managed forest show substantial increases in carbon sequestration over passive forms of management(James et al. 2007). A careful scientific review of the claims made in the Sierra Pacific Industry report found that the report's conclusions were not fully consistent with the results of calculations (Krankina 2008).The analyses showed that the report relied on unrealistic carbon yields, and relied on some assumptions that are questionable and others that are demonstrably untrue. One of the assumptions dealt with the amount of carbon stored in pools, including wood products. Krankina (2008) states; The assumption that forest products taken out of service and transferred to landfills retain carbon in perpetuity (p. 29; bottom) is clearly untrue. While the decomposition is slow in landfills it does occur and carbon is gradually released into the atmosphere. The no-decomposition assumption is yet another one that biases the results in favor of intensive management scenario. ... Finally, the assumption that wood products are taken out of service at an annual rate of 1% per year is also unrealistic. This would imply that 50% of long-term wood materials produced in 1930-ies are still in service today Krankina (2008) concludes that; The 'several significant flaws' in the report's methodology bias the calculation results in favor of intensive

management.(See below for more detailed information regarding the SPI report). In addition, Mackey et al. (2008) argue that to truly evaluate the benefits of wood products, it is necessary to account for all carbon losses and gains associated with logging and associated industrial processes if we are to look at this from a carbon-mitigation perspective. Comprehensive carbon accounting is needed that includes carbon uptake and emissions from all human activities associated with commercial logging and processing of the associated wood-based products, as well as carbon storage in products. Due to the immense amount of carbon spent harvesting trees, it is likely that the amount stored in wood products is minimal in mitigation terms.

In addition to severe climate and carbon implications, the impacts of clear cutting/plantation forestry reach further to biodiversity and overall forest health. For instance, as discussed in Mackey et al. (2008), the difference between natural and managed/plantation forests is considerable when addressing a broad range of issues Natural forests are more resilient to climate change and disturbances than plantations because of their genetic, taxonomic and functional biodiversity. This resilience includes regeneration after fire, resistance to and recovery from pests and diseases and adaptation to changes in radiation, temperature and water availability. Regrowth forests and plantations have reduced genetic diversity and structural complexity, and therefore reduced resilience to pests, diseases and changing climate conditions (Hooper and Vitousek 1997; Hooper et al. 2005, McCann 2007). The significance of these impacts is even more apparent when considered cumulatively in light of other land use changes and overall impacts from climate change. In general, natural forests provide 1) carbon that spends a longer time in the system, 2) a system that is more resilient to environmental perturbations and 3) natural processes that enable ecological systems and their component species to respond to changing conditions. These differences between natural and managed forests have already been found to have important implications for California forests. A study modeling climate change impacts on the productivity, health, and value of a forest in the Sierra Nevada highlights the impact that climate change will have on these ecosystems, specifically plantations. Battles et al. (2008) found that, conifer tree growth was reduced under all downscaled climate change scenarios. The reductions in growth were most severe (31 %) for pine plantations - a common management regime for industrial landowners. Only 18% decreases in productivity were reported for mature stands (a status representative of approximately 20% of the federal forest in the region).To reiterate, logging has significant negative impacts on carbon stores. It decreases the number of existing large trees/old trees, reduces the carbon stored in forest soils and floors, reduces and prevents the development of carbon stores, reduces the resilience of the forest ecosystem to the impacts

of climate change, and is not offset by the amount of carbon stored in harvested materials and wood products. All of these issues must be appropriately and adequately addressed if the THP is to meet its CEQA obligations. As stated in Joy Road Area Forest Watershed Assn. v. California Dept. of Forestry Fire Protection, _[any] analysis which understates information concerning the severity and significance of cumulative impacts impedes meaningful public discussion and skews the decision maker's perspective concerning the environmental consequences of the project, the necessity for mitigation measures, and the appropriateness of project approval.142 Cal. App. 4th at 667.

RESPONSE: While the concern cited above is lengthy, the issues all revolve around the use of the clearcutting silvicultural method. Therefore, rather than make repetitious comments about each sub-concern under the general heading, the Department is responding to the entirety of the concern about clearcutting and GHG. In this effort, the Department examined the studies listed in the concern in order to determine the impact that scientific studies might have on any finding that the Department might make on any particular THP or cumulative groups of THPs with respect to a potential significant adverse environmental impact on GHG. With this in mind, the study for Janisch & Harmon (2002) was reviewed and it was found that the study was done in the Pacific Northwest on primarily old-growth forests types where some of these were clearcut and converted to plantation. The type of stands that the Department is dealing with in the case of this and related THPs are not old-growth stands and are not located in the Douglas-fir/true fir type found in costal areas of the Pacific Northwest. A quote from Janisch & Harmon (2002) bears out this difference: "When off-site and burned CWD stores are accounted for and C accumulation is summed over time, logging old-growth Pseudotsuga-Tsuga forests creates a CO_2 debt that may persist for more than 150 years, even when old-growth forests are replaced with vigorously growing secondary forest. If stand history is not considered, NEP-based determinations of whether stands function as CO_2 sources or sinks can be misleading. This is because C stores in old-growth stands may differ vastly from C stores in second-growth stands that replace them, because woody biomass exported form a site may not be reflected in NEP, and because substantial fractions of stand C stores may be lost in rapid pulses easily missed by short-term monitoring." (emphasis added) This report concludes, therefore, that there are vast differences between the behavior of old-growth as studied in the report and the type of second and even third growth stands of this and related THPs.

The report by Skog and Nicholson (2000) presents interesting facts about the fate of wood and paper products, and as stated in the issue above, much of those products produced between 1910 and 2000 were decomposed or destroyed and released into the atmosphere. However, there is a great deal of difference between the way forest products were used in the first half of the 20th century vs. how they are used in modern times. For example, as the report points out: "If, when taken out of use, products are disposed of in a modern landfill, the literature indicates that they will stay there indefinitely with almost no decay." And "Wood and paper sent to landfills (or dumps prior to 1986) includes residue from solid wood mills (in very limited amounts), construction and demolition waste, and discarded paper, paperboard, and solid wood products. These same materials are sometimes burned with or without energy. Prior to 1972, most materials were placed in dumps....". In most cases, modern laws require the use of landfills for disposal of these material when prior to these laws, materials were exposed to the elements in dumps. The report also points out other changes over time, such as the half-life of carbon in a single family home pre-

1980 being 80 years, while the post-1980 estimate in a half-life of 100 years.

With the study by Krankina et al. (2004), the Department does not find that the study concludes that "clearcutting does not increase the amount or maximize stored forest carbon." This kind of finding was not even envisioned in the purpose of the study, which was attempting to use remote sensing to track carbon storage in a Scots pine/Norway spruce forest near St. Petersburg, Russia. One could also argue that the area of the study alone and forest type would not bear data that would be easily transferable to a temperate zone, mixed conifer forest in the Sierra Nevada. However, the report also found that: "STANDCARB projects the net C flux in forest ecosystems ranging between -5 and +4 MgC ha yr. C losses greater than 3 MgC ha yr are limited to 3-4 year period following timber harvest, 15 years after harvest C accumulation in live biomass offsets the emissions and the net flux is predicted to become positive. The highest rates C accumulation are predicted between ages 20 and 35 in forests of high productivity (2.4-3.6 MgC ha yr) and between ages 20 and 30 in forests of medium productivity (1.8-2.5 MgC ha yr). In low productivity forests the peak growth period is later and less prominent (0.7-1.1 MgC ha yr between ages 25 and 40). By the end of 150-year simulation the rate of C accumulation declines with forest age..." The forest area studied in Russia was said to have 35000 to 40000 ha harvested per year and another 3,000 ha affected by fire. Given this, there was still an accumulation of C, and the report concludes: "The current accumulation of C in live forest biomass will likely continue into the future unless there is an increase of timber harvest to twice the 1993 level."

The study by Harmon et al. (1990) also talks about conversion of old-growth forests and in fact the title of the study is "Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests". The study does not equate well with the type of second or third growth forest which is not growing at it's potential, as in the case of this particular and related THPs under consideration by the Department. Likewise, there is no evidence that the converted young forests are being intensively managed with genetically superior tree stock. Likewise, this is another study done in the Pacific Northwest in a Douglas-fir forest that is probably not at all similar to a mixed conifer temperate zone forest in the Sierra Nevada. But if the Harmon study can be expanded to the Sierra Nevada mixed conifer forests, it also predicts that fluctuations in soil C are expected to stabilize by the second or third rotations (Page 700). This suggests that soil C fluctuations as described by Harmon would have already stabilized in these forests.

The report Depro et al. (2008) also does not appear to conclude anything with respect to clearcutting and carbon storage versus other silvicultural methods, although the report shows that public lands can be managed to increase carbon sequestration by adopting a "no harvest" policy. At present, a "no harvest" policy on private industrial timberland is not responsive to public policy in the Forest Practice Act or in TPZ zoning. The report does contain useful information, such as: "Although the soil carbon pool is the second largest carbon storage pool in aggregate in the United States (Birdsey and Heath, 1995), Heath et al. (2002) note that little change in soil carbon occurs if forests are regenerated after harvest." The report also treats wood products allocated to energy as a C sink, as follows: However, we have also included calculations that treat energy uses as a sink for GHG emissions, assuming that biomass energy sources from the forest sector substitute for fossil fuel energy sources and serve as an offset for those emissions." The Department wonders if this offset is considered a C sink because one is using renewable wood energy sources instead of non-renewable fossil fuels. If that is the case, could the same be said about using

renewable wood building materials rather than using non-renewable stone/cement/steel etc. building materials? The report also lists "understory vegetation" as the smallest component of total carbon stock, and while forest floor carbon constitutes the third largest carbon storage pool, this pool is much smaller than tree or soil carbon pools.

For the analysis of Harmon (2007), see the Response to Issue #1 in this Official Response.

The study by Mackey et al (2008) was done in a eucalyptus forest in Australia which is very dissimilar to the mixed conifer temperate zone forest in this particular and related THPs. While the mixed conifer forest is an evergreen type forest, it is not a hardwood evergreen forest as is the eucalypt. There is really no way of knowing if any of the results from this type of forest could be applicable to the situation in this particular and related plans. The study by Roxburgh et al. (2006) suffers from the same fate as it also was done in Australia. The study does find, however: "These results imply that through regrowth and recovery from past disturbance (logging), previously managed temperate Eucalyptus forests may be currently functioning as significant sinks for atmospheric carbon." Intertwined in the Roxburgh et al. (2006) study were quotes in the letter of concern for Brown et al. (1997). Brown's study was in eastern USA hardwoods, and not in western mixed conifers. Again, the Brown study compares old-growth (hardwoods) with young-growth (hardwoods), and the current and related THPs are not old-growth types and do not contain significant amounts of hardwood types. The quote from Varmola and Delungo (2003) also compares the carbon stock of a commercially logged forest with that of a "natural, undisturbed forest." The Department sees the same problem with this study where we are not starting with an undisturbed forest and where policies are in place that encourage zoning for timber production and place a value on the production of high quality forest products.

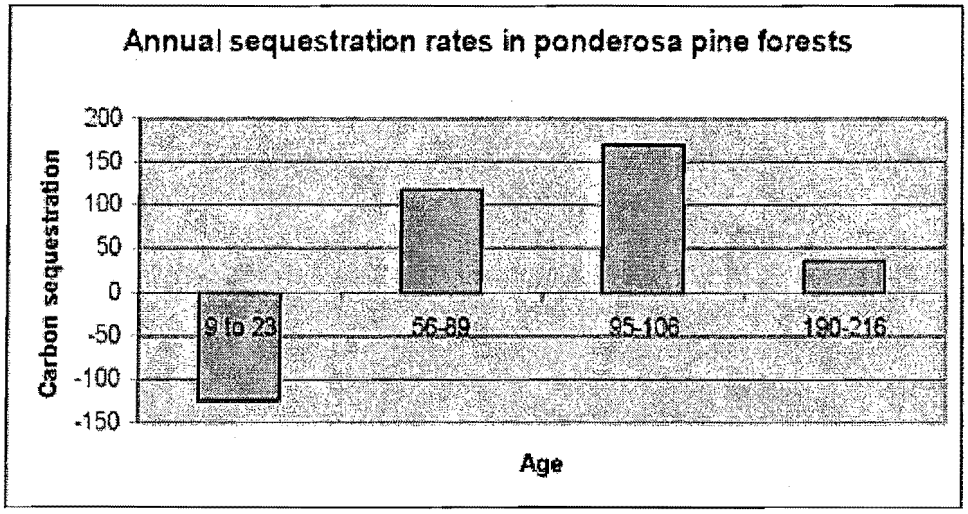
The report Cohen et al. (1996) was again done in the Pacific Northwest where there was clearcutting in largely old-growth forest types. However, while not directly comparable to the mixed conifer harvest on second or third growth, the report did contain the following: "These mature and old-growth forests are generally slow growing, such that they are at most only a moderate carbon sink or stable." Also, "But under ideal conditions, especially with plantation forestry, return to a closed-canopy conifer state is generally expected within 20 years, according to forestry professionals of the PNW region. By the time this young conifer state is reached, accumulation of biomass by live trees is expected to result in high rates of carbon sequestration. This latter point also is revealed in Table 1 in which our estimates show that <u>young conifer stands were the largest net carbon sinks over the study period</u>." (emphasis added) This finding is consistent with the position of the Department on plantation stands managed over time for spacing, where competition is being controlled and using genetically superior planting stock, as is the case with this and related THPs. Likewise the report Dixon et al. (1994) shows that there is a lack of accounting in global models which do not consider the role of improved forest management techniques, as follows: "In summary, large uncertainty exists with our ability to project future forest distribution, composition, and productivity. Moreover, global models have not been developed that consider the role of improved forest management in mitigating C flux to the atmosphere under transient or nontransient climate change scenarios."

Quotes from Noss (2001) are included in the letter of concern and these quotes provide general guidance to future forest management from a "Koyoto Treaty" perspective. The report is global

and generally discusses possible policy changes as follows: "Plantation management, where it is appropriate, should emphasize mixed-species forestry and native species, which would allow migrating species to be incorporated into the mix. Although shortened rotations would enable quicker response to forest dieback or other symptoms of changing climatic conditions, the risk of depleting critical soil nutrients and facilitating species invasions would also be higher." The Department and rules of the BOF already speak to forest management and LTSY of plantations and/or other forest components, and allow for capture of "forest dieback" which could result from extreme climate change in the future; other policy changes might be needed, however, as discussed in Noss (2001). The report has another finding with respect to wildfire: "Curiously, a 300-year fire history in the boreal forest of Quebec shows a significant decrease in the number and extent of fires in the absence of fire suppression, beginning with a warming period 100 years ago, suggesting that the predicted increase in fire with climate change is by no means universal. In any case, efforts to protect forests from intense fires through regular, prescribed burning and/or understory thinning have been much more successful than efforts to suppress intense fires." This quote from Noss (2001) encourages some type of management of forests in order to reduce the potential of intense wildfire, as is practiced on the land under management in this THP. Policies of the BOF already contain encouragements for forest management that reduces fire load and allows for reduced stocking in shaded fuelbreaks designed to break-up the continuity of forests and interlocking crowns and ladder fuels that promote the spread of wildfire.

The report Jandl et al. (2007) does not necessarily contain dire predictions about the effect of clearcutting on forest soil carbon. In fact, the report states: "A review of harvesting techniques suggested that the effect on soil C is rather small, on average, and depends on the harvesting type. Whole-tree harvesting caused a small decrease in A horizon C stocks, whereas conventional harvesting, leaving the harvesting residues on the soil, resulted in a small increase. Although soil C changes were noted after harvesting, they diminished over time <u>without lasting effects</u>." (emphasis added) The report also suggested that: "Several modeling studies suggest that very long rotation lengths do not necessarily maximize the total C balance of managed forests. In a simulation experiment of the effect of increased rotation length on C storage in Scots pine plantations in Finland, Germany, and Spain stand productivity declined, because the currently applied harvest age was already beyond the maximum annual increment." The report also stresses the need to consider fire management as follows: "Recommendations for forest management need to consider the regional disturbance regime. Fire has always played an integral role in the structure and function of forest ecosystems, especially in seasonally dry forests. The policy of fire suppression can delay but cannot prevent wildfires over the long term. It leads to an apparent net C accumulation that in fact increases the risk of large C release during catastrophic fires." As noted, the current THP and policies of the BOF manage the forest with the threat from wildfire foremost in mind. Jandl et al. (2007) also states: "Climate change may increase the frequency and intensity of drought, especially in the Mediterranean and temperate zones. The impacts are site specific and difficult to predict. Water limitations will tend to affect tree growth negatively, but on the other hand the decomposition of soil C may be reduced." The Department finds that this is an interesting but unanticipated potential result of climate change.

The concern letter provided a graphic intended to show that net ecosystem productivity (NEP) in ponderosa pine forests is greatest in mature forests (ages 95-106 years) and least in youngest stands (9-23 years old). This is the graphic provided in the concern letter.



The source of the data for the graph was given as Law, et al. (2003), however the data was not presented as a bar graph in that document. Table 4 in Law, et al. (2003) provided measurements for each of four age classes. The use of average values for each of the age classes created a misleading graph, the fact that mature and old stands can be sources was not depicted or acknowledged. It is interesting to note that while the stands at initiation were negative one plot had a NEP value that was comparable to one the mature stands and was actually less of a source than old stand. The only age class that showed positive NEP values for all three plots measured was the young stands.

Table 4 Annual carbon fluxes of ponderosa pine stands in the Metolius area of central Oregon

Plot ID	Age class*	NPP_A	NPP_B	R_{hS}	R_{hCWD}	R_{hFWD}	ΔC_{CR}	ΔC_{FR}	ΔC_S	NEP
25	*I*	158 (49)	150 (37)	368 (64)	7 (2)	16 (5)	20 (4)	0 (2)	0 (97)	−83 (17)
26	*I*	109 (53)	45 (23)	299 (69)	56 (14)	43 (11)	17 (2)	0 (2)	0 (97)	−244 (29)
27	*I*	75 (22)	87 (75)	173 (79)	16 (4)	18 (5)	15 (2)	0 (2)	0 (97)	−44 (6)
28	*Y*	251 (45)	119 (39)	179 (66)	6 (2)	7 (2)	49 (9)	0 (5)	0 (129)	177 (28)
29	*Y*	200 (34)	175 (54)	294 (72)	8 (2)	14 (4)	45 (9)	0 (5)	0 (129)	60 (33)
30	*Y*	242 (57)	212 (42)	290 (78)	33 (9)	14 (4)	46 (14)	0 (5)	0 (129)	117 (32)
31	*M*	325 (71)	222 (69)	333 (107)	12 (3)	12 (4)	71 (18)	0 (1)	0 (17)	190 (39)
32	*M*	172 (81)	78 (36)	264 (98)	19 (5)	7 (2)	20 (20)	0 (1)	0 (17)	−40 (41)
33	*M*	473 (118)	186 (80)	245 (155)	39 (10)	16 (4)	88 (34)	0 (1)	0 (17)	359 (58)
34	*O*	243 (77)	167 (35)	213 (94)	12 (3)	18 (5)	53 (22)	0 (2)	0 (22)	168 (41)
35	*O*	103 (36)	112 (48)	189 (64)	17 (5)	6 (2)	17 (10)	0 (2)	0 (22)	4 (23)
36	*O*	194 (84)	176 (57)	408 (110)	21 (6)	8 (2)	33 (24)	0 (2)	0 (22)	−67 (41)

Values are in grams carbon per m^2 ground basis unless indicated otherwise. Uncertainties are shown in parentheses. Uncertainty estimates were determined by using various estimates of component errors and propagating this error through the computation of each flux either arithmetically or through Monte Carlo simulation of 1000 iterations (See Methods and materials).
*I, initiation; Y, young; M, mature; O, old.

NPP_A, Aboveground net primary productivity; NPP_B, Belowground net primary productivity; R_{hS}, Heterotrophic respiration in soil; R_{hCWD}, Respiration of coarse woody detritus; R_{hFWD}, Respiration of fine woody detritus; ΔC_{CR}, Net change in coarse root C pool; ΔC_{FR}, Net change in fine root C pool; ΔC_S, Net change in soil C pool; NEP, Net ecosystem productivity.

Some of the narrative attributed to Law, et al. (2003) in the comment letter appears to be based on the bar graph and not the actual data. Statements such as "Numerous studies have shown that old-growth forests continue to sequester carbon from the atmosphere; Law et al. 2003 ..." do not acknowledge the negative NEP recorded by Law, et al. (2003) for plot 36.

Stated in the Issue #2 above was a quote from Birdsley & Heath (1995) as follows: "Nationally about 2/3 of the historical and projected positive flux is carbon buildup in the soil and forest floor. ... A search of the literature indicated that a major forest disturbance such as a clearcut harvest can increase coarse litter and oxidation of soil organic matter. The balance of these two processes can result in a net loss of 20% of the initial carbon over a 10-15 year period following the harvest (Pastor and Post 1986, Woddell et al. 1984)." This, however, turned out to be a partial quote as the entire quote from pg. 3 of the study follows: "Nationally about 2/3 of the historical and projected positive flux is carbon buildup in the soil and forest floor. ... A search of the literature indicated that a major forest disturbance such as a clearcut harvest can increase coarse litter and oxidation of soil organic matter. The balance of these two processes can result in a net loss of 20% of the initial carbon over a 10-15 year period following the harvest (Pastor and Post 1986, Woddell et al. 1984), **although a recent review suggested that the net effect may be less or even positive in many cases (Johnson 1992).** (from Birdsley & Heath, 1995)." The same study that was purported to be so negative in regards to clearcut harvest also quoted: "After the initial 20% loss of soil carbon after harvest, it was assumed that soil carbon would return to pre-harvest levels by age 50 in the South and 55 elsewhere. (Birdsley & Heath, 1995)." It seems apparent from the use of the word "assumed" that there was no actual data present in the study to come up with these figures, but it can be noted that the projected rotation age of plantation stands for this particular THP and for the SPI Option "a" are well beyond the 55 year stats used in the study. This study also states that "Between 1952 and 1992, carbon stored on forest land in the conterminous U.S. has increased by an estimated 11.3 billion metric tons. This is an average of 281 million metric tons of carbon sequestered each year over the 40-year period, an amount that has offset about one fourth of the U.S. emissions of carbon to the atmosphere. (Boden et al., 1990)" (from Birdsley & Heath, 2007, pg. 7). Apparently, U.S. forests are contributing greatly to CO_2 sequestration, even at a time prior to 1992 when timber harvest levels in the west and California were high compared to current levels as discussed elsewhere in this Official Response.

Covington (1981) was quoted in the letter of concern as stating that there was a 50% decrease in forest floor mass at 15 years after logging northern hardwoods and that the decrease is due to lower leaf and wood litter and more rapid decay from higher temperatures and moisture. While this study was done in hardwoods and not mixed conifer, there are interesting findings in the text of the study. For example, the study actually says that "During the first several years when the forest floor mass is rapidly declining, wood litter input is low. By years 10-20, it is increasing at its greatest rate, which would coincide with the turnabout in the curve for forest floor organic matter content." Also, "However, forest floor depth 50-60 yr after cutting appears to be comparable to that of old growth stands." (emphasis added)

There is no quote in the study attributed to Buchmann and Schulze (1999) that refers to continued release of carbon into the atmosphere for decades after logging. The actual conclusion of the study was that, after examining 139 ecosystem gas exchange studies, there was shown to be gaps in knowledge for certain vegetation types. Most of the existing studies at the time focused on undisturbed sites in northern latitudes and there was found to be little information about tropical regions. One fire disturbed forest from Siberia was quoted in the study as being a net source of CO_2 for at least 14 years. This is certainly not the "decades" that were quoted in the letter of concern. While the quote from the letter of concern might have come from the other study mentioned (Bergeron et al. 2007), that study was done in black spruce in a boreal forest condition in Canada and not in mixed Sierra conifer from California's temperate zone. Even in the black spruce plots, there were vast differences found between the sampled areas, as stated in the report.

The two studies that were also done on boreal forest conditions in Canada are from Lecomte et al. (2006) and Fredeen et al. (2005) and both of these are in spruce forests and not mixed Sierra conifer. Growing conditions and the length of the growing season are entirely different in boreal regions when compared to ternperate zones. In fact, many publications recognize the distinction between temperate as contrasted with boreal and as contrasted to tropical. At any rate, the fact that these boreal forests emit carbon into the atmosphere for a longer period than a temperate forest after disturbance would be expected given the shorter growing season and colder temperatures at the boreal site. Also, tree growth in seedlings would be expected to be much slower at these latitudes so that it would logically take longer for the trees to change from a carbon source to a carbon sink.

While the study Nabuurs et al. 2007 quotes the theoretical point of maximum carbon storage as the condition where all stands in the landscape are in an old-growth state, this and other studies also indicate that this is a condition where the forest is close to being in balance. That is, there is little additional sequestration of CO_2 from the atmosphere, nor is there very much carbon released. This is perhaps not the ideal situation if one were trying to get increases in sequestration. In fact, the study goes on to promote ways to increase sequestration by:

> "... the options available to reduce emissions by sources and/or to increase removals by sinks in the forest sector are grouped into four general categories:
> • maintaining or increasing the forest area through reduction of deforestation and degradation and through afforestation/reforestation;
> • maintaining or increasing the stand-level carbon density (tonnes of carbon per ha) through the reduction of forest degradation and through planting, site preparation, tree improvement, fertilization, uneven-aged stand management, or other appropriate silviculture techniques;
> • maintaining or increasing the landscape-level carbon density using forest conservation, longer forest rotations, fire management, and protection against insects;
> • increasing off-site carbon stocks in wood products and enhancing product and fuel substitution using forest-derived biomass to substitute products with high fossil fuel requirements, and increasing the use of biomass-derived energy to substitute fossil fuels"

An interesting study by Luyssaert et al. (2008) shows that old-growth forests can continue to remove CO_2 from the atmosphere. However, even this study, which breaks from the traditional

view of a carbon neutral old-growth condition, shows decreases in added biomass under some growing conditions, especially tree density. The study states: "On the basis of our global data set we find that in forests between 15 and 800 years old, the NEP is usually positive: that is, the forests are CO_2 sinks." Also the report states: "There is some degree of age-related decline in NPP beyond 80 years of age, and temperate and boreal forests both show a consistent pattern of declining NPP beyond an early maximum when analyzed separately." These quotes would indicate that, while old-growth forests can accumulate CO_2, they may not do so to the extent of forests at a younger age. At any rate, no old-growth forests are being considered for harvest in the current and closely related THPs. The quoted study by Harmon et al. (1990) again deals in the conversion of old-growth forests to young-growth and this study was done in the Pacific Northwest. This type of conversion is not being anticipated in this and closely related THPs under consideration by CAL FIRE for the central Sierra Nevada.

The study by Pregitzer and Euskirchen (2004) is quoted to indicate that old-growth forests store up to four times as much carbon as middle-age forests. However the study also states: "Aggregated biome-level estimates of NPP and NEP were higher in intermediate-aged forests (e.g., 30-120 years), while older forests (e.g. > 120 years) were generally less productive." Also "The mean R was high in the youngest temperate age class and declined with age, implying that forest ecosystem respiration peaks when forests are young, not old." Clearly there is a difference between C storage and C sequestration. This report also makes the point quoted above that there are three separate growing biomes globally, as follows: "Living biomass C increased with age across boreal, temperate, and tropical forests, as would be expected." Finally the comment related to soil C: "Mean and median organic soil horizon pool sizes increased with age in boreal, temperate, and tropical forests, reaching a peak in the 71 or older age classes. The standard deviations within an age class and the box plots clearly demonstrate that organic soil horizon pool sizes are highly variable across all three biomes."

The report from Smith et al. (2004b) does not contain the quote attributed to it in the letter of concern. This study is simply demonstrating an approach to estimating forest carbon for large areas by using inventory data: "This article demonstrates how forest ecosystem carbon budgets can be compiled for forestlands of tens of thousands to millions of hectares based on readily available forest inventory data from the conterminous United States." Likewise, the paper Smith et al. (2006) does a similar job of calculating carbon in forest ecosystems in different regions of the United States. The quote from the study that was used in the letter of concern compares the amount of carbon stored in five year old stands of birch compared to 125 year old stands of birch. The message is that, as a stand gets older, it has more tree volume, and this obvious fact says nothing about sequestration rates or the fate in the environment of the carbon from forest products that might be derived from a stand of trees.

The report Seely et al. (2002) was done in lodgepole pine, aspen, and spruce in a boreal condition in Canada. The report is quoted as again saying that older stands stored more biomass, which has already been discussed by the Department in paragraphs above. However, regarding sequestration rates, the report states: "Species-specific biomass accumulation rates (an index of ecosystem productivity) were maximal in the shortest rotations for aspen, but in mid-length rotations for pine and spruce. Short rotation scenarios showed a marked drop in site productivity over subsequent rotations. The application of nitrogen fertilizer reduced the relative drop in site

productivity for aspen. Our results suggest a trade-off between ecosystem storage capacity and timber production. By selecting the appropriate tree species and rotation length, however, it is possible to either balance these competing demands, or favour one value versus the other."

The letter of concern quotes sources as saying that old-growth forests can continue to sequester carbon, as previously discussed. However Dewar & Cannell (1992) indicates that 95% of carbon storage is reached by 80 years, therefore the additional amount sequestered over the next generations until "old-growth" is reached amounts to the remaining 5%. Therefore, the rate of sequestration has slowed considerably. Desai et al. (2004) shows old-growth to be a small carbon sink and not as good as mature forest. Field and Kaduk (2004) shows that old-growth are not important for the rate of carbon storage. While Chen et al. (2004) also shows old-growth capable of continuing to store carbon, it also explains that: "...this suggests that single locations are not representative of the overall landscape which limits the application of these results to broader spatial scales." Again, the Department notes that old-growth harvesting is not a part of this THP or closely related THPs that have been or now are under consideration. The quote from Law et al. (2003) followed the other findings in this paragraph by finding that older stands can continue to store carbon. However a close examination of the graphs provided show a slowing rate after a time and these trees are growing in a drier site with a shorter growing season in eastern Oregon as compared to a warmer and wetter temperate mixed Sierra conifer location for the current project. Trees on the Oregon site would logically be expected to reach maximum growth at an older age than the Sierra site that is the subject of this THP.

To determine whether or not clearcutting of an individual acre will have an adverse impact is addressed by the Department through a Life Cycle Analysis approach. The Department recognizes that Life Cycle Analyses (LCA) utilizing even-aged silvicultural systems have not been done for California species. In the absence of California specific LCAs, the Department reviewed LCA results for conifer species managed under short rotation even-age harvesting regimes (Birdsey and Lewis 2002, Oneil et al 2007). In both cases the rotations evaluated were generally shorter than those which will be utilized by California timberland owners. In both cases the trends in carbon accumulation over one or a series of rotations show increasing sequestration. The Oneil data trends, when the impact of substitution is factored in, showed high levels of accumulated carbon and avoided emissions. Although wood product substitution does not permanently eliminate carbon from the atmosphere it can and does offset the use of more GHG-intensive fuels.

When leakage to account for replacement of wood products foregone from these stands as well as wildfire are factored into to a life cycle analysis, it is likely that unmanaged stands may show a net emission at some point in the future. From a policy perspective this may be an appropriate decision based on other resource or societal considerations, but it should not be assumed that from a GHG perspective that a decision to forego management of a forest stand is the best choice from a global warming and greenhouse gas reduction perspective.

It is also likely that some carbon will be lost from the soil carbon pool as a result of this operation through the harvesting and subsequent site preparation activities. As discussed previously, site preparation activities will facilitate faster site occupancy and crown closure of the developing stand post harvest. The pattern of soil carbon dynamics based on the literature review in the Heath and Smith (Gen. Tech. Rep. RMRS-GTR-59, 2000) paper indicates a consistent pattern of initial

increases in soil carbon following harvest, followed by a period of a loss of 11 to 20 percent of the soil carbon, followed by a period of recovery. It is unclear from their review what site preparation methods were used but one study in loblolly pine utilizing pre-harvest low intensity burns showed recovery to above pre-harvest levels of soil carbon within 13 years.

Heath and Smith (2000) summarize soil carbon accounting and assumptions for forestry and forest related land use change. Their conclusions based on a review of existing literature on harvesting impacts on soil carbon pools were summarized as follows:

> "Based on this preliminary review, soil carbon dynamics following harvest appear to depend on the amount of disturbance caused by logging operations. The disturbance associated with some commercial harvests may cause soil carbon to increase initially in the first few years by 8-13 percent, and then decline to below initial values by 11-20 percent by 10-20 years after harvest, and eventually increase again. Some studies showed changes in soil carbon below the 0-30 cm depth, indicating that experimental soil studies should sample lower soil depths. Severely eroded soils also create additional problems concerning depth because much of the original soil may be eroded. Results compare at..."

Other researchers have also concluded that managed forests have been shown to sequester more carbon and have fewer emissions than unmanaged forests (Birdsey et al. 2000, Krankina and Harmon 2006; Hoover and Stout 2007). It is clear that while carbon storage and sequestration rates in unmanaged stands is high, active management of forest stands to produce wood products can also be a viable option for improving or maintaining sequestration. Contributions of wood products should not be ignored nor should the substitution benefits of wood products compared to other building materials. That said, it is also recognized that forests which will be managed to maintain or create old growth, even though growth on mature trees will slow, ecosystem storage of carbon may increase as a result of increases in other carbon pools (Zhou et al. 2006; Schulze et al. 2000).

Comparisons of long rotation or no harvest scenarios to shorter rotations need to be done in light of leakage, wood products substitution benefits, low carbon fuel benefits associated with woody biomass, etc. All of these factors would need to be analyzed through a life cycle analysis comparison of the various management scenarios. These types of life cycle analyses have not been completed although it can reasonably be inferred that a relatively broad range of management scenarios can support high levels of sequestration. The Department's analyses of rotation length (Robards, 2008) while not exhaustive did indicate that a 50 to 80-year rotation length will capture a high proportion of the sequestration production capacity of a given site depending on site productivity. Decisions to require longer rotations need to balance the GHG implications with other resource values. For California privately owned timberlands, production of wood products is recognized as one of the uses that will occur on these landscapes.

Regarding the concern over clearcutting creating habitat fragmentation, stands within Class I and II WLPZ areas under the Forest Practice Rules will likely occupy from 10% to 12 % of a given planning watershed. Harvest entries into WLPZ areas under the current Forest Practice Rules will be light when entries do occur. The frequency of harvests in the WLPZ areas will be influenced by harvesting in the upslope even-aged units and are anticipated to be far less frequent than would

be likely if the upslope areas were managed under an individual tree selection regime. The stands that develop in the WLPZ areas will provide for mature stand conditions. In combination with the upslope stands which will be greatly represented by stands at or near rotation age, at the landscape level depending on rotation age selected 30 to 60% of the area will be occupied by stands with relatively large average diameter trees.

The Impacts to existing wildlife populations of non-listed species based on the selection of an even-aged management regime are not likely to threaten to push populations of currently non-listed species to a point that would require mitigation. Listed species and species of special concern have been addressed at the biological assessment area level and take avoidance strategies will be applied at the THP level. The potential for adverse impacts to non-timber resources which would need to be mitigated to avoid impacts to wildlife, plants or other benefits have been identified in the plan and appropriate mitigations have been included in the THP.

The issue of ecosystem resiliency is certainly an important one. It is recognized that California will get warmer. Changes in precipitation type and timing will impact wildfire behavior, influence natural regeneration, exacerbate competition stressors, and drive increased frequency of epidemic insect and disease. Both natural and managed forests will be impacted by the change in climate and the frequency of wildfire, insects, and changing factors with respect to reproductive success. Research by Thorne et al. (2006) corroborates the basic assumption that vegetation shifts will occur. Their analysis of Wieslander Vegetation mapping for the Placerville quadrangle indicate that at low elevations, blue oak and foothill pine have largely converted to grassland and that the lower edge of the yellow pine belt has retreated upslope about 180 meters between 1934 and 1996 and by 526 meters since 1850. The authors attribute the elevational changes in distribution to the failure of conifer establishment.

Forest types in California will likely move both attitudinally and altitudinal. As noted in the April/May Journal of Forestry Article titled "Potential Effects of Climate Change on Forests":

> "...Past episodes of climate change have witnessed forest migration rates of approximately 50 kilometers per century, with some species achieving even greater rates of migration (Schwartz, 1993; Noss 2001). The current rate of climate change may exceed the rate at which forests can respond (Woodwell et al., 1998)....Past, present, and future fragmentation of forestland may inhibit dispersal and establishment, significantly reducing migration rates (Schwartz, et al. 2001; Walther et al. 2002; Opdam and Wascher 2004)....However, an increasing frequency of large-scale disturbances is likely to facilitate the spread of invasive species into forest systems as well (Iverson and Prasad 2002)."

Lenihan's et al. conclusion regarding net primary productivity of simulated ecosystems concluded:

> "...ecosystem net primary productivity (NPP showed considerable interannual and interdecadal variability, especially over the first half of the 21st century when NPP was frequently greater than normal...even under the drier GFDL scenarios. From about mid-century on, there was a general increasing trend in NPP under the relatively cool and wet PCM-A2 scenario, and a general decreasing trend under the warmest and driest GFDL_A2 scenario (Figure 5a)...

...Net biological production (NBP) is the balance between carbon gained by the ecosystem via net primary productivity, and carbon lost from the ecosystem via decomposition and consumption by fire....The simulated trends in cumulative NBP under the warmer and drier GFDL scenarios (Figure 5b) showed a steady decrease over the course of the future period,...These losses represent a decline in total carbon stocks of 1.3%(B1) and 2.2%(A2), respectively (Table 2)..."

Forest Management as a means of controlling stocking, reducing fire risk, matching tree species to anticipated changes in conditions, responding to insect infestations, etc. can and will be utilized to maintain NPP in managed stands.

For forest ecosystems the two greatest vectors that will drive change in distribution of vegetation types will be fire and moisture stress attributable to changing precipitation patterns. While total precipitation under most climate change models is predicted to remain roughly the same as the current level, the form of precipitation is expected to shift proportionately to a higher proportion of rain as opposed to snow. The result of this shift will be longer periods of time during any one growing season when soil moisture will be at critical levels. Combined with the likelihood of more high temperature days, tree mortality levels are expected to increase along with a decrease in regeneration success. In additions, wildfire under all of the modeled climate scenarios is also expected to increase.

Drought and related mortality associated with interplant competition will be just as likely to impact stands of older trees as overstocked stands of young trees. Both a natural and a management adaptation response to provide for resiliency would generally dictate a reduction in stocking to reduce interplant competition or a species shift. Management would allow for utilization of the material removed, reduce fuel loading, reduce CO_2 releases associated with decomposition of dead material, reduce emissions associated with wildfire and provide for wood products that can be substituted for other more CO_2 intense building alternatives. Clearly not all acres need to be managed nor will they be to improve resiliency. However, it is the Department's conclusion that forest management will have benefits in terms of improving forest health and resiliency of managed stands and that forest management represents a viable option as part of any adaptation strategy.

Additionally, wildfires will increase in frequency across the landscape. Lenihan et al. (2006) studied the response of vegetation distribution, carbon and fire to three future climate change scenarios for California. Their conclusions in the abstract of their report regarding fire were:

"Total annual area burned in California increased under all three scenarios, ranging from 9%-15% above the historical norm by the end of the century. Regional variations in the simulated changes in area burned were largely a product of changes in vegetation productivity and shifts in the relative dominance of woody plants and grasses. Annual biomass consumption by fire by the end of the century was about 18% greater than the historical norm under the more productive PCM-A2 scenario. Under the warmer and drier GFDL scenarios, simulated biomass consumption was also greater than normal for the first few decades of the century as drought-stressed

woodlands and shrublands burned and were converted to grassland. After this transitional period lower than normal NPP produced less fuel, and biomass consumed was at or below, the historical norm by the end of the century under the GFDL scenarios".

Lenihan also notes the considerable uncertainty that exists with respect to the modeling and assumed trajectories of the future greenhouse gas emissions.

The effects of wildfire in terms of increasing forest fire severity in the Sierra Nevada and southern Cascade Mountains of California were quantified by Miller et al. (2008). Their conclusions indicate that fire intensity is increasing over time and that for the areas for which data was analyzed:

> "In our study area, forest types most affected by increasing fire severity are those which 1) form the majority of the National Forest land base; 2) support most remaining habitat for a suite of old-forest obligate carnivores and raptors...3) see the heaviest resource extraction and recreation use, and 4) are experiencing rapid growth in human populations...."

Based on Miller's conclusions increasing fire severity can be expected in both older stands and those which are subject to timber harvesting. Miller recognizes that use of fire in Yosemite was limiting fuels and reducing the probability of fire recurrence. While this may be a viable management strategy for maintenance of older stands, use of fire does result in emissions. Without the use of fire the probability of any given stand including old stand experiencing a fire event over the next century is high. As was observed in the Miller study the probability of a stand replacing fire is increasing.

Oneil, et al. studied the sequestration emission outputs for unmanaged stands in Eastern Washington. His conclusions regarding the carbon storage, sequestration, and emissions relationships for the stands analyzed were as follows:

> "Federally managed forests produce a different set of carbon related issues. If we assume no harvest, no fire and no insect and disease impacts on national forests in eastern Washington, the carbon sequestration potential of these forests is approximated by Figure 7. However, McKenzie et al. (2004) indicates that we can expect at least a doubling of fire frequency and extent in eastern Washington. Linking this research to work done by Camp on the historic levels of fire refugia (i.e. the area that didn't burn under historical fire conditions) suggests that under the most optimistic climate change scenarios approximately 1.7% of the acres of national forest's in eastern Washington would burn in each decade. Using this 1.7% as a 'back of the envelope' calculation would generate the forest carbon footprint given in Figure 8. Figure 8 gives what we would hope is an upper bound of the carbon release potential if these forests burn at rates predicted by recent climate change research. If the forests burn at rates higher than anticipated under climate change scenarios, then there would be more emissions from these forests. In this rough approximation, regeneration is not estimated as regeneration delays and failure rates would need to be more accurately estimated. That 'black' component would be residual burned wood that decays, and

thus releases carbon, at a rate of approximately 0.5 tons/carbon/acre/year. The grey component is the equivalent emissions released from the burned forest based on 6 tons/acre emitted for every acre burned (Mason et al. 2003). While this is a very cursory examination of potential impacts which is in need of much refinement, it does highlight how unmanaged forests are likely to become a source of carbon emissions rather than a sink."

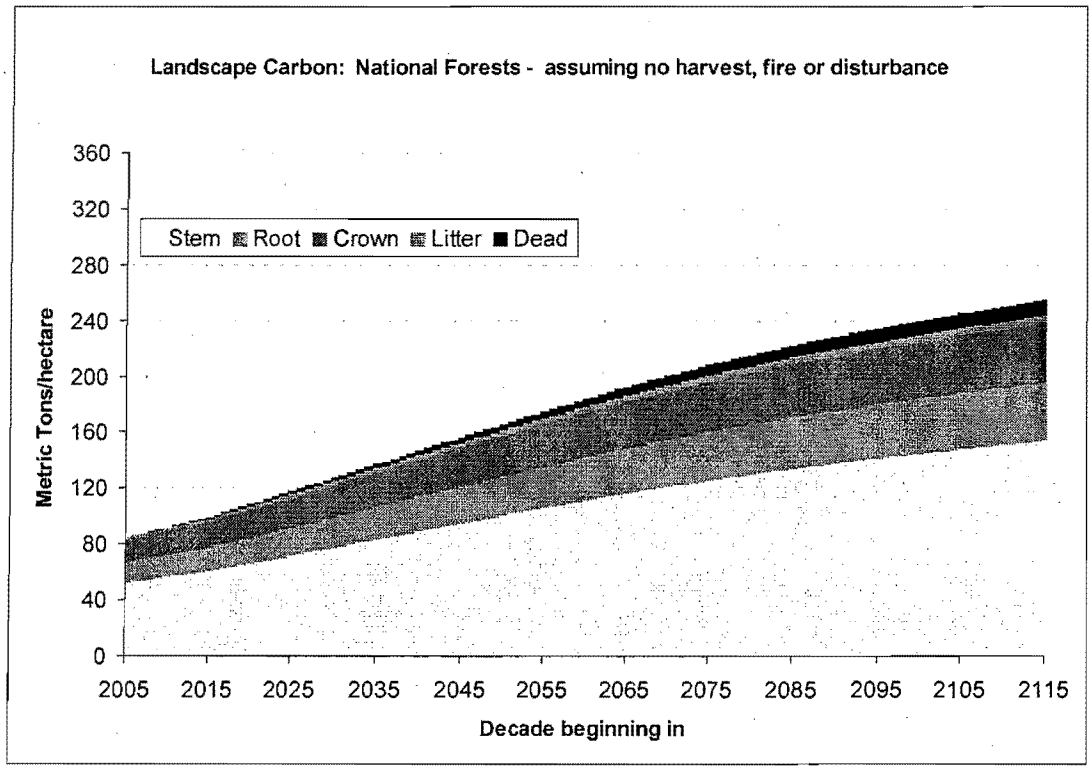


Figure 7: Tons per hectare carbon pools for national forests in eastern Washington assuming no management

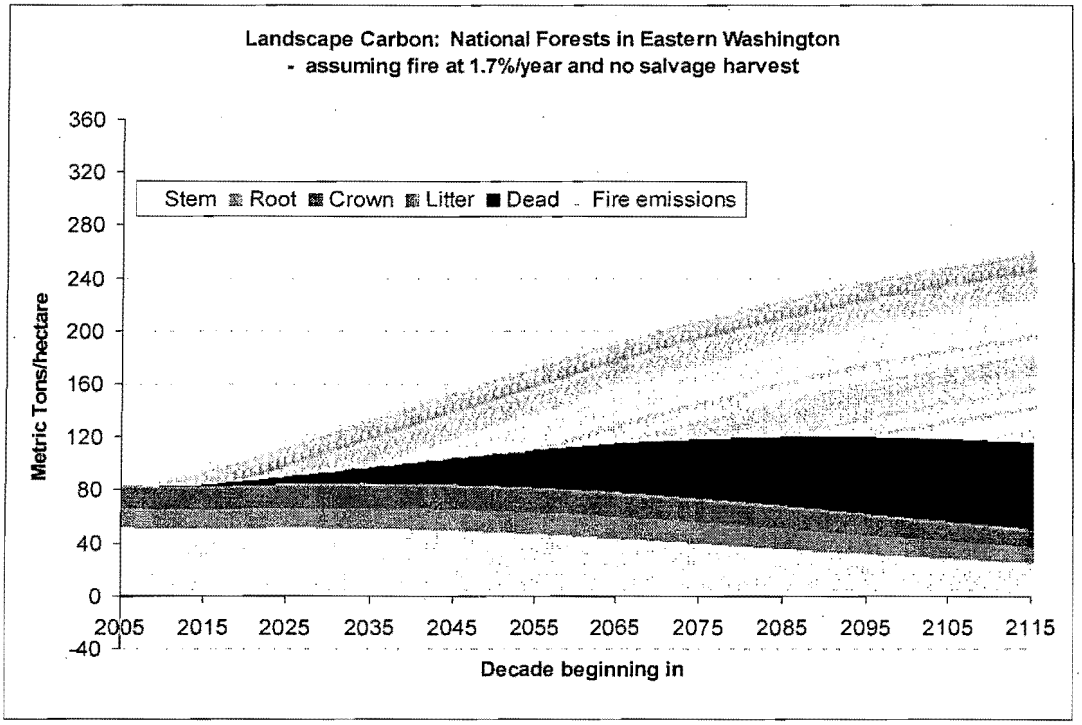


Figure 8: Tons per hectare carbon pools for national forests in eastern Washington assuming a 1.7% burn rate based on climate change estimates

While these examples have been developed for Washington forest types, the general relationships for California species will likely be similar for our drier forest types. It is the Department's conclusion that a strategy designed to maintain large old trees without managing the associated understory fuels is not the best model for either improved resilience to wildfire or reduce greenhouse gas emissions associated with wildfire in the reserved areas. However, the tradeoffs are largely policy calls which are outside the scope or influence of the THP project and the plan submitter's control.

For stands where forest management will occur, the relationship between post harvest condition and fire behavior is relatively well understood. Forest management applications that appropriately address fuel hazard considerations can create conditions favorable to stand survival. The basic science and recommendations for post harvest conditions have been described in Morris, et al. (2007) "Guide to fuel treatments in dry forests of the Western Unites States: assessing forest structure and fire hazard". The types of stands to be created through forest management regimes will lend themselves well to fuel reduction prescriptions described in the guide. Further, the forest management regimes will support both forest health as well as resiliency from a wildfire standpoint. It is the Department's conclusion that the even-aged management regime will likely afford more options for management applications that will enhance forest health, resistance to wildfire, and ecosystem resiliency.

With respect to the concern about impacts of clearcutting on carbon storage and sequestration rates in comparison to old growth stands, the Department recognizes that comprehensive carbon accounting is useful in determining the carbon footprint associated with any particular silvicultural

regime. The most commonly accepted approach to this type of comprehensive review is Life Cycle Analysis. At this point Life Cycle Analyses utilizing even-aged silvicultural systems have not been done for California species. In the absence of California specific LCAs, the Department reviewed LCA results for conifer species managed under short rotation even-age harvesting regimes (Birdsey and Lewis 2002, Oneil et al 2007). These analyses do consider the emissions from human activities associated with the logging and processing of wood products as well as storage of wood products in various applications and in landfills. In both cases the trends in carbon accumulation over one or a series of rotations show increasing trends in carbon sequestration. The Oneil data trends, when the impact of substitution is factored in showed high levels of accumulated carbon and avoided emissions. Although wood product substitution does not permanently eliminate carbon from the atmosphere it can and does offset the use of more GHG-intensive products.

As a subset of this concern, an issue is raised about carbon storage in wood products. It is the Department's conclusion that the assertion in this concern that wood product storage is minimal from a climate mitigation perspective is not generally supported by the literature. The Oneil data along with conclusions reached by other analysts (Valsta 2007, Birdsey and Lewis 2003, Kozak and Gaston, 2003) indicate that wood products both in use and in landfills sequester significant quantities of carbon. Kenneth E Skogg, USDA Forest Service, Forest Products Laboratory reported in a paper titled "Carbon Sequestration in Wood and Paper Products" that:

> "Overall, the rate of net sequestration of carbon to products in use and landfills increased ~170 percent between 1970 and 1990 from 22 to 59 tg/year...This increase was due in part to the increase in product consumption; round wood use increased 51 percent between 1970 and 1991... It is also due to a sharp increase in the rate of accumulation of carbon in landfills with the shift from dumps to landfills in the 1970s and 1980s."

The importance of carbon storage represented by wood products in use or land filled is hardly minimal. Skogg also points to a 1993 RPA [Resources Planning Act] Base case projection for the forest products sector which projects a decline in rate of carbon sequestration from 274 Tg in 1990 to 161 Tg in 2040 citing analysis done by Birdsey and Heath in 1995. The reasons cited for the slowdown in accumulation is attributed to the aging of the forests as forests reach an age of slower tree growth, slower increase in soil carbon and a reduced harvest on public land in the West along with more intensively managed areas of former old growth.

The issue in the letter of concern about short rotation lengths has surfaced in numerous past concerns regarding a variety of resource areas. From a climate perspective short rotations can sequester significant carbon if the wood products are long-lived (Perez-Garcia et al 2005). SPI manufactures types of wood products that generally would be classified as long-lived from a sequestration accounting standpoint.

The Journal of Forestry in its April/May 2008 issue (Vol. 106, Number 3) notes in an article titled "Reducing Atmospheric GHGs through Sequestration" that:

"Forests of all ages and types have remarkable capacity to sequester and store carbon. Enhancement of this capacity depends on ensuring full stocking, maintaining health, and reducing losses due to tree mortality, wildfires, insect, and disease."

If the only forest management goal is to sequester carbon, both short-rotation intensive management and old-growth management may be appropriate.

Oneil et al. (2007) summarized recent work by CORRIM which has completed life cycle analyses which include analysis of management effects on four major carbon pools including:

1) carbon in the forest;
2) carbon in products that leave the forest;
3) carbon associated with the use of biomass and product residuals as an energy source; and
4) the carbon offsets from the substitution that occurs when wood building materials displace products like steel or concrete.

The Oneil summary of the CORRIM report is as follows:

"A major finding in the CORRIM report is that forests that are periodically harvested, planted, and re-grown to produce a continuing series of short-and long-lived products and energy feedstock's, sequestered and offset more carbon than forests that are left unharvested...."

Oneil's life cycle work shows that carbon in the forest has a relatively constant upward trend line and that carbon in product pools net of energy used in harvesting, processing and construction increases over time. Substitution of renewable and carbon neutral wood products for higher fossil fuel-intensive building products also contributes to the carbon balance of forest management.

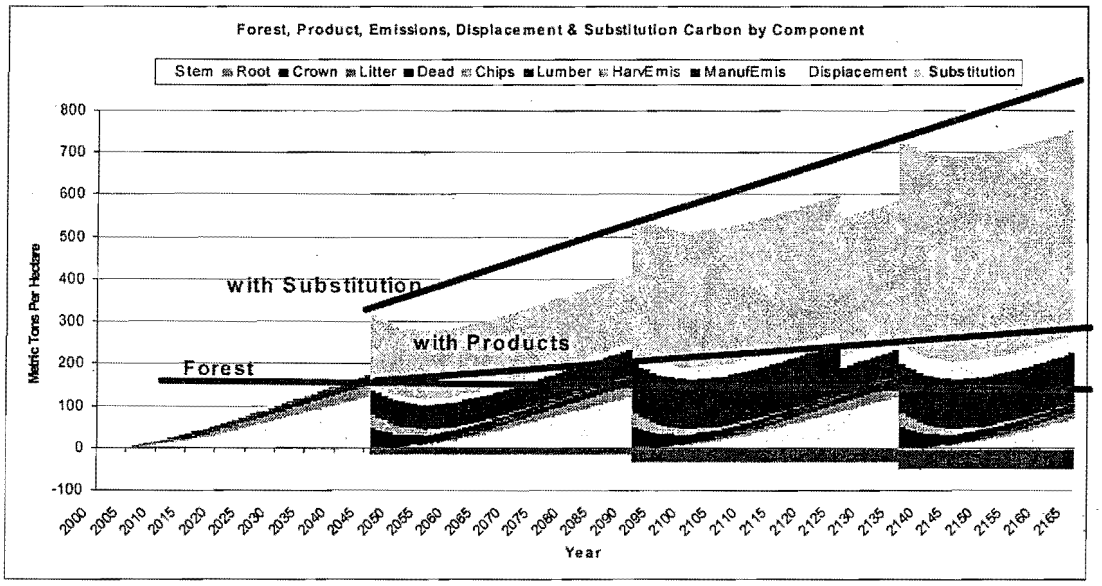


Figure 4: Carbon pools for a single acre of commercial forest under a 45-year rotation.

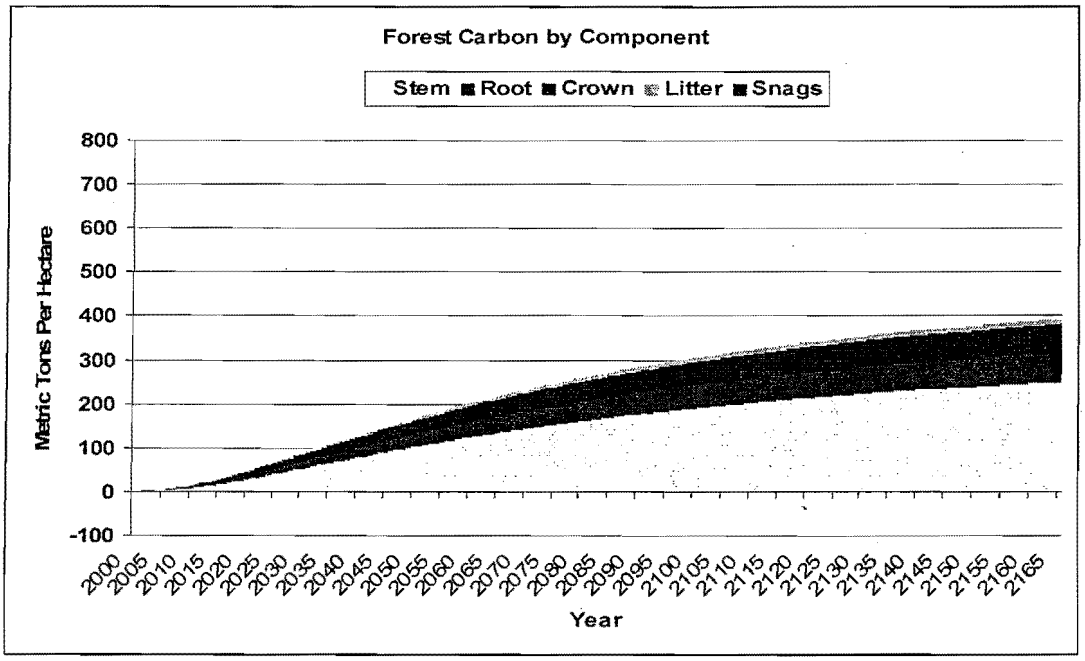


Figure 5: Carbon pools for a single acre of forest with no harvest and no disturbance.

The age at which the growing stock of a regulated forest will produce the greatest annual return in volume is the point at which mean annual increment and periodic annual increment curves intersect (Matthews, 1935). Mean annual increment is computed by dividing the volume of a stand at any one point by its age. Periodic Annual Increment reflects the change in volume in a stand over a period of time divided by the length of the period. Periodic Annual Increment (PAI) typically peaks much earlier in the development of a stand than Mean Annual Increment (MAI). Information on stand volumes and age for California species were described in a series of yield tables published largely in the 20's, 30's and in the 60's (Dunning et al. 1930; Schumacher, 1930; Schumacher, 1926; Meyer, 1938, 1961; Lindquist, et al., 1963). From a carbon perspective the most pertinent metric from a carbon sequestration standpoint reported in these various yield tables is total production in terms of cubic feet per acre. This metric in most of the yield tables reflects the total woody biomass for the stems of the trees measured from stump to tip exclusive of the bark and limbs. For the major California species:

Ponderosa pine-MAI cubic feet productivity for all trees 0.6" at dbh and greater peaks at age 50 for all site classes and PAI at 25-35 years (Meyer 1938.
White fir- MAI cubic feet productivity for all trees culminates at 70 years (Schumacher, 1926)
Douglas-fir-MAI cubic feet productivity culminates at 40 to 50 years for site indexes of 80 feet and above (50-year basis)(Schumacher, 1930).
Mixed conifer-MAI cubic foot productivity culminates at 70 years for all species Dunning, et al. 1933)
Redwood-MAI cubic foot productivity culminates at 50-70 years for medium to high sites and PAI culminates at 20-40 years (Lindquist, et al., 1963).

Rotation ages for California species from a cubic foot perspective for the major species groups based on the relationship of MAI and PAI would be shorter than current Forest Practice Rule requirements if the sole objective was to maximize volume on a cubic foot production basis. From a climate perspective, maximizing volume production from a carbon stock and sequestration standpoint would need to consider other carbon pools and impacts of a particular management regime on total carbon. These carbon pools include soil, branches, bark, below ground roots, stumps, wood products, substitution benefits, etc. and would likely be best reflected in a life cycle analysis approach.

From a GHG standpoint, it is the Department's conclusion that short rotations can sequester significant carbon. This is particularly true as is the case for California where wood products generated from harvesting activities are long-lived (Perez-Garcia et al 2005). California wood products companies manufacture types of wood products that generally would be classified as long-lived from a sequestration accounting standpoint. If the only forest management goal is to sequester carbon, both short-rotation intensive management and old-growth management may be appropriate.

Regarding the issue of the impacts of plantations on biodiversity, Stephens and Wagner 2007 summarized their review of studies conducted to evaluate the impacts of forest plantations on biodiversity. Their conclusion based on this review was as follows:

> "Our review of the literature indicates that the majority of studies examining the impact of plantation forests on biodiversity are making inappropriate comparisons. Only five studies reviewed made moderately appropriate comparisons. We argue that the most appropriate comparison is plantation forests to the land use they are replacing, be that native/natural forest condition or an alternate land use. It is unrealistic to compare exotic monoculture plantations to natural forest conditions. The categorical conclusion often cited that plantation forests reduce or negatively impact biodiversity, must be rejected and replaced by a more conditional conclusion. Increasing biodiversity is a desired outcome that can be achieved through appropriate forest management that includes the use of plantations."

The seven studies that were reviewed by Stephens and Wagner which compared native stands to plantations of native trees concluded:

> "...Native-species forests are capable of providing a more habitable environment with structural and understory conditions more similar to natural forests. Clearly if we compare "apples to apples" i.e. native forests to native species plantations, the difference in biodiversity nearly disappears."

Based on Department observations of older plantations such as the approximately 30 year old Granite Burn plantation in Tuolumne County or the 50 to 60 year old Wrights Creek burn also in Tuolumne County, stands do develop structures as stands develop dominant, co-dominant, intermediate, and suppressed crown classes, tree diameters increase and understory vegetation becomes established.

While the size and spatial arrangement of stands will be different at the point that the timberlands have the balance of age classes projected under the proposed management regimes, there will be a variety of seral stages that will likely provide for habitat diversity. Adverse impacts to existing non-listed species are not anticipated. Impacts to listed species will be addressed through take avoidance or through compliance with Habitat Conservation Plans and Natural Community Conservation Plans and/or site specific THP level mitigations.

Regarding the concern over potential for reduction in plantation productivity in light of climate change, growth and yield for plantations, particularly plantations of ponderosa pine, has received considerable attention and research (Oliver and Powers, 1978, Oliver 1972, Oliver 1979). SPI has modeled yield for their established plantations and LTSY calculations are based on consistency of silvicultural application and the accuracy of the growth projections for these regenerated stands. This modeling shows increasing in-woods inventory as well as increased harvest levels over the next 100 years.

It is recognized that California will get warmer but the level of warming is not known. At the global scale there is scientific consensus that climate is changing and will change in response to increased concentration of greenhouse gases in the atmosphere. The research on how this warming climate will impact forests is underway with a number of researchers testing vegetation responses under a series of warming scenarios. Kahrl and Roland-Holst (2008) in summarizing the impacts of climate change on agriculture, forestry and fishing state:

> "Climate change will mean significant changes for agriculture, forestry and fisheries in California. In lower warming scenarios, some of these changes will be beneficial for agriculture and forestry, although there is some debate about the net impact. Both higher and likely lower warming scenarios, even if they cause no net economic impacts will lead to gradual but substantial change in the composition and location of agricultural, forest and fish production... Forestry will experience high yields, but also higher fire risk and drought vulnerability...."

Lenihan, Bachelet, Drapek and Neilson (Lenihan, et al. 2006) evaluated through modeling the impacts on vegetation cover for various vegetation classes. Their conclusions based on the modeling were as follows:

> "Significant declines in the extent of Alpine/Subalpine Forest were simulated under all three scenarios, especially under the warmest GFDL-A2 scenario. At high elevation sites the model responded to longer and warmer growing seasons, which favored the replacement of Alpine/Subalpine Forest by other vegetation types.
>
> The simulated extent of forest land in the state (i.e., the combined extent of Evergreen Conifer Forest and Mixed Evergreen Forest) increased relative to the historical extent by 0.5% under the PCM-A2 scenario. Forest cover declined by) 0.6% and 0.9% under the GFDL-B1 and GFDL-A2 scenarios, respectively.
>
> Evergreen Conifer Forest declined under all scenarios, but the largest declines were simulated under the warmer and drier GFDL scenarios. Much of the simulated loss of

this type was due to replacement by Mixed Evergreen Forest with increases in temperature, but reductions in effective moisture and increases in fire also resulted in losses to Evergreen Conifer Forest to Woodland, Shrub land, and Grassland."

Lenihan's et al. conclusion regarding net primary productivity of simulated ecosystems concluded:

> "...ecosystem net primary productivity (NPP showed considerable interannual and interdecadal variability, especially over the first half of the 21st century when NPP was frequently greater than normal...even under the drier GFDL scenarios. From about mid-century on, there was a general increasing trend in NPP under the relatively cool and wet PCM-A2 scenario, and a general decreasing trend under the warmest and driest GFDL_A2 scenario (Figure 5a)...
>
> ...Net biological production (NBP) is the balance between carbon gained by the ecosystem via net primary productivity, and carbon lost from the ecosystem via decomposition and consumption by fire....The simulated trends in cumulative NBP under the warmer and drier GFDL scenarios (Figure 5b) showed a steady decrease over the course of the future period,...These losses represent a decline in total carbon stocks of 1.3%(B1) and 2.2%(A2), respectively (Table 2)..."

Forest Management as means of controlling stocking, reducing fire risk, matching tree species to anticipated changes in conditions, responding to insect infestations, etc. can and will be utilized to maintain NPP in managed stands.

Zhang et al., (2008) evaluated and modeled future stem volume in plantations established during the reforestation of the 1992 Fountain Fire which is located in eastern Shasta County . Their findings indicate:

> "...by the age of 36 years, the young plantations will carry as much stem volume as the pre-fire stands at about the age of 70 years (Figure 3), indicating that a fully stocked plantation with understory vegetation controlled grows much more bole wood than a natural stand does on the same lands...."

assessing whether a Project's effects on climate change are cumulatively considerable, even though its GHG contribution may be individually limited, the lead agency must consider the impact of the project when viewed in connection with the effects of past, current, and probable future projects. . .. Lead agencies should not dismiss a proposed project's direct and/or indirect climate change impacts without careful consideration, supported by substantial evidence. Documentation of available information and analysis should be provided for any project that may significantly contribute new GHG emissions, either individually or cumulatively, directly or indirectly (e.g., transportation impacts). Accordingly, because the THP's "felling of the .. , trees" will contribute to greenhouse gas emissions, CAL FIRE must unequivocally consider the THP's emissions to be a cumulatively significant impact. In sum, the contribution of THPs to carbon emissions is a serious and significant problem, and therefore it is important that THPs perform a thorough analysis of their cumulative contribution to carbon emissions and that CAL FIRE adequately address the issue. Many THPs are currently under consideration for approval, many THPs have recently been approved, and there are numerous past and future THPs - all of these must be considered together, and along with the effects of past, current, and probable future projects that are also contributing to global warming, in order to properly account for their cumulative impact to greenhouse gas emissions. Until that occurs, no THP will be in compliance with CEQA.

RESPONSE: The Department recognizes its responsibility under the Forest Practice Act (FPA) and CEQA to determine whether direct or cumulative environmental impacts will be significant and adverse. In the case of the management regime which is part of the Whitmore Grade THP, significant adverse impacts associated with the proposed application over the 100-year sustained-yield planning horizon are not anticipated. This conclusion is based on the information provided in the Option "a" that demonstrates increasing inventory and growth and research and modeling results reviewed by the Department. The Department has concluded that the impacts from implementation of this management regime will have a net benefit from a climate perspective. Recognizing that thresholds have not been established is not germane given that adverse impacts have not been identified.

With respect to SPI's Option "a", CAL FIRE has independently analyzed and reviewed the literature associated with climate change, analyzed and reviewed the information contained in the THP, and other pertinent information and has determined that the THP and the SPI Option "a" is in conformance with the rules of the BOF. Actual field measurements are made to obtain growth and yield information relative to the demonstration of MSP in the Option "a" plan associated with the current THP 4-08-24/AMA-1. The rules of the BOF found in 14 CCR 953.11(a) that pertain to a demonstration of MSP provide that the goal of MSP is to be demonstrated through: " (1) Producing the yield of timber products specified by the landowner, taking into account biologic and economic factors, while accounting for limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to, recreation, watershed, wildlife, range and forage,

fisheries, regional economic vitality, employment and aesthetic enjoyment; and, (2) Balancing growth and harvest over time, as explained in the THP for an ownership..." As the rules also state: "The projected inventory resulting from harvest over time shall be capable of sustaining the average annual yield achieved during the last decade of the planning horizon." As stated above and in the Response to Concern #1 and #2, the combination of projects on SPI ownerships will have a beneficial impact on climate based on execution of the management regime described in SPI's Option "a".

The Department recognizes that growth on California's forested landscapes remain below the potential productivity (FRAP 2003). Forest management through aggressive reforestation, enhancement of conifer site occupancy, genetic improvement, thinning, etc. can and will improve productivity on managed lands while balancing other resource values and providing positive benefit from a climate perspective. This positive benefit will come from increased inventory (i.e., carbon stock), increased growth (i.e., sequestration) and sequestration, storage in wood products and landfills, as well as substitution benefits attributable to forest management life cycle analyses. The Department also reviewed LTSY projections for the 2020 and 2050 periods for all larger landowners and it indicated that inventories are expected to increase. Given the LTSY projections for the larger landowners, the trend indicated in the FIA data relative to increases in growing stock volume and growth through 2050 is likely to continue.

As discussed in the Response to Concern #1 in this Official Response, the Department has cumulatively reviewed LTSY projections for the 2020 and 2050 periods for various landowners. The Option "a" documents which were evaluated cover approximately 3.2 million acres and show that inventory harvest is less than growth through 2020 and 2050 and that as a result inventory (carbon storage) and growth (sequestration) will improve significantly over current levels.

To determine direct and cumulative benefits of carbon storage in the forestlands of the State, the Department has worked with the Air Resources Control Board (ARB) to assist with development of the 1990 baseline for the Forest Sector and assisted ARB with workshops and liaison with the Board of Forestry and Fire Protection as part of the AB32 Scoping Plan development. The Scoping Plan was adopted in December of 2008 and establishes a year 2020 target for the Forest Sector of 5 million metric tons of carbon sequestration. Achievement of this target will require that the Sector maintain present estimated levels of net sequestration. Essentially this represents a no net loss strategy for the Forest Sector as a whole. Management regimes which maintain or increase inventory and growth will contribute to this objective. As we have discussed in previous responses, the Department has concluded that the estimates of inventory increase and growth for SPI's timberland are reasonable and that net sequestration over time will increase in support of the AB 32 targets. Adoption of a zero significance threshold in this case is not necessary given that the management regime will result in a net benefit from a climate standpoint.

The scoping plan adopted by the California Air Resources Board (CARB) included targets and goals for the management of private timberlands which are under the existing authority of the BOF and made recommendations for public timberlands in California as well. These measures include the maintenance of the current level of carbon sequestration through sustainable management practices including reducing the risk of catastrophic wildfire and avoiding land-use changes that

reduce carbon storage. In addition to the negative impacts from the risk of wildfire and land-use change, the ruling pointed out the risk of insect attack on timberlands. The ruling also pointed out that; "The Board of Forestry and Fire Protection, working with the Natural Resources Agency, the Department of Forestry and Fire Protection and ARB would be tasked with developing a monitoring program, improving greenhouse gas inventories, and determining what actions are needed to meet the 2020 target for the Forest sector." This ruling was only adopted in October 2008, and as yet, the Board has not promulgated regulations affecting forest practices in this area. In the interim, however, CAL FIRE has examined the record of the history of logging in California to examine the changes that have occurred over time in order to determine if it is likely that the level of carbon sequestration in the forest sector can be maintained pursuant to the scoping plan target. For timber harvesting alone, the Board of Equalization, Timber Tax Division, keeps records of the volume of timber harvested in the state because they collect taxes on these amounts to be distributed to various counties. From the BOE; "The average annual volume of 1.96 million MBF in the period 1995-2005 was 53% of the 3.73 million MBF in the 1985-1994 annual average. Since the high in 1988, total volume declined an average of 2.18% per year from 4,688 MMBF to 1,730 MMBF in 2005. Much of this fall off is due to reduced harvest on public lands, which is readily seen below in the statistics from the Board of Equalization.